Xcel Energy[SM]

PUBLIC SERVICE COMPANY

IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR A COMMISSION DECISION (1) APPROVING ITS STEAM RESOURCE PLAN, (2) CONDITIONALLY GRANTING IT A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY TO CONSTRUCT ONE OF TWO NEW BOILER PROJECTS COMMENCING IN 2016, AND (3) GRANTING SUCH OTHER AND FURTHER AUTHORIZATIONS AND WAIVERS AS THE COMMISSION MAY DEEM NECESSARY

PROCEEDING NO. 14A- ____ST

DIRECT TESTIMONY AND ATTACHMENTS OF TIM M. FARMER

NOTICE OF CONFIDENTIALITY
A PORTION OF THIS DOCUMENT HAS BEEN FILED UNDER SEAL

Confidential: Attachment No. TMF-2A, Attachment No. TMF-3A, and Attachment TMF-4A

December 18, 2014

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

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IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR A COMMISSION DECISION (1) APPROVING ITS STEAM RESOURCE PLAN, (2) CONDITIONALLY GRANTING IT A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY TO CONSTRUCT ONE OF TWO NEW BOILER PROJECTS COMMENCING IN 2016, AND (3) GRANTING SUCH OTHER AND FURTHER AUTHORIZATIONS AND WAIVERS A THE COMMISSION MAY DEEM NECESSARY	)	**PROCEEDING NO. 14A-_____ST**

DIRECT TESTIMONY AND ATTACHMENTS OF TIM M. FARMER

ON

BEHALF OF

PUBLIC SERVICE COMPANY OF COLORADO

December 18, 2014

BEFORE THE PUBLIC UTILITIES COMMISSION
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<u>SUMMARY OF THE DIRECT TESTIMONY OF TIM M. FARMER</u>

Mr. Tim M. Farmer is the Engineering and Construction Manager of Engineering for Xcel Energy Services Inc. In this position, Mr. Farmer has responsibility for managing fleet-wide standards and processes for design, engineering and technology for power plant capital projects within Energy Supply. This position is also responsible for design, engineering and technology associated with either new or re-powered units.

In his Direct Testimony, Mr. Farmer provides an assessment of the Zuni Plant for near-term continued operation, and reviews feasible supply-side alternatives that the Company identified and analyzed to supply the steam customers into the foreseeable future. Mr. Farmer provides the details for each of the projects that the Company proposes to meet the short-term and long-term needs of its steam customers and the information typically found in a Certificate of Public Convenience and Necessity ("CPCN") application for those applicable projects.

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

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GLOSSARY OF ACRONYMS AND DEFINED TERMS

Acronym/Defined Term	**Meaning**
CHP	Combined heat and power
CPCN	Certificate of Public Convenience and Necessity
DSP	Denver Steam Plant
E&C	Engineering and Construction
ERP	Electric Resource Plan
IP	Intermediate Pressure
LP	Low Pressure
Mlb(s)	Unit of Measurement for Steam Energy. One pound of saturated steam contains 1,000 Btus of heat energy. One Mlb of steam = 1,000 lbs/steam. Therefore one Mlb of steam = 1,000,000 Btus of heat energy
O&M	Operations and Maintenance
pph	pounds per hour
Public Service or Company	Public Service Company of Colorado
SSP	State Steam Plant
SVSC	Sun Valley Steam Center
XES	Xcel Energy Services, Inc.

LIST OF ATTACHMENTS

Attachment No. TMF-1	Zuni Plant Assessment Report
Attachment No. TMF-2	Steam Supply Options Report
CONFIDENTIAL Attachment No. TMF-2A	Confidential Steam Supply Options Report
Attachment No. TMF-3	Attachment 1 to Steam Supply Options Report – Capital Cost Estimates
CONFIDENTIAL Attachment No. TMF-3A	Confidential Attachment 1 to Steam Supply Options Report – Capital Cost Estimates
Attachment No. TMF-4	Attachment 2 to Steam Supply Options Report – Operation and Maintenance Cost Estimates
CONFIDENTIAL Attachment No. TMF-4A	Confidential Attachment 2 to Steam Supply Options Report – Operation and Maintenance Cost Estimates
Attachment No. TMF-5	Denver Steam Plant Expansion Representative Equipment Layout (aerial photo)
Attachment No. TMF-6	Zuni Unit 1A Upgrade Project Schedule
Attachment No. TMF-7	State Steam Plant map
Attachment No. TMF-8	State Steam Plant aerial photo
Attachment No. TMF-9	State Steam Plant Interconnection to Intermediate Pressure Distribution System Project Schedule
Attachment No. TMF-10	Denver Steam Plant expansion representative equipment layout drawing
Attachment No. TMF-11	Denver Steam Plant Expansion Project Schedule
Attachment No. TMF-12	Zuni Plant and Sun Valley Steam Center site aerial photo
Attachment No. TMF-13	Zuni Plant and Sun Valley Steam Center map

Attachment No. TMF-14	Sun Valley Steam Center building rendering
Attachment No. TMF-15	Sun Valley Steam Center Mechanical Equipment layout drawing
Attachment No. TMF-16	Sun Valley Steam Center Project Schedule

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

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DIRECT TESTIMONY AND ATTACHMENTS OF TIM M. FARMER

I. INTRODUCTION, QUALIFICATIONS AND PURPOSE OF TESTIMONY

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Tim M. Farmer, 1800 Larimer, Denver, Colorado 80202.

Q. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A. I am employed by Xcel Energy Services Inc., ("XES") the service company affiliate of Public Service Company of Colorado ("Public Service" or "Company"). My position is Manager of Engineering.

Q. WHOM ARE YOU REPRESENTING IN THIS PROCEEDING?

A. I am testifying on behalf of Public Service.

Q. HAVE YOU INCLUDED A DESCRIPTION OF YOUR QUALIFICATIONS, DUTIES AND RESPONSIBILITIES?

A. Yes. A description of my qualifications, duties and responsibilities is included as Attachment A.

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY IN THIS PROCEEDING?

A. I will provide testimony regarding the Company's assessment of the best means to meet the needs of our district steam customers, both in the short-term (the next 3-5 years) and on a going forward basis. In particular I discuss the viability of continuing steam operations at Zuni Station in the short-term pending implementation of a long-term service solution. While the Zuni Station unit is at the end of its service life, we have determined that, with the proposed modifications and repairs I discuss, the unit can provide steam for up to an additional five years, albeit with risks typical of a plant already in operation for more than 60 years. We base this conclusion on the Zuni Assessment Report that we completed, which I provide as Attachment No. TMF-1, and the Steam Supply Options Report that we prepared to address both short-term and long-term supply issues, which I provide as Confidential Attachment No. TMF-2A. The Steam Supply Options Report itself includes exhibits relating to capital cost and operations and maintenance ("O&M") expense for various supply options. I provide these as separate, confidential attachments: Confidential Attachment No. TMF-3A (capital cost estimates for the supply-side options), and Confidential Attachment No. TMF-4A O&M cost estimates for the supply-side options.

I also discuss the long-term steam supply side options that the Company investigated, as set forth in more detail in the Steam Supply Options Report.

I provide the following information in support of this Application: 1) a detailed description of both the short-term supply side solutions the Company proposes as well as the long-term supply side options we are considering, including available drawings; 2) a construction schedule for completing each of the potential capital improvements proposed in this filing, including the start date, construction period and in-service date for each project; 3) the project costs estimates for each of these potential capital improvements, including detail on how the Company developed these estimates; and 4) maps showing where these facilities will be located. I am providing Attachment Nos. TMF-1 through TMF-16 in support of my testimony. I already summarized Attachments Nos. TMF-1 through TMF-4 above, and will address the remaining attachments later in my testimony.

Q. WERE THESE ATTACHMENTS PREPARED BY YOU OR UNDER YOUR DIRECT SUPERVISION?

A. Yes, they were.

Q. PLEASE PROVIDE A DESCRIPTION OF THE COMPANY'S DISTRICT STEAM SYSTEM AND OPERATIONS.

A. Public Service operates a Commission regulated district steam system that produces and distributes steam to customers in downtown Denver. In fact, Public Service is the only Commission-regulated steam service provider in the state. Public Service's steam business has a long history, having been originally incorporated as the Denver City Steam Heating Company in December 1879. The system is the oldest, continuously operating commercial steam utility in the world.

The Company's district steam system includes three steam boiler stations and a distribution system, enabling us to deliver steam to our 129 steam customers. The Company's steam service territory encompasses an area in downtown Denver that extends roughly from Zuni Street to 20th Street and from Wewatta Street to 13th Avenue. Employees assigned to the Steam Department are engaged in steam supply operations and maintenance, distribution operations and maintenance, customer activities including metering and billing, sales, marketing, technical assistance, customer service, general and tariff administration, and new customer installations. The Company operates its steam business and supplies steam service to our customers on a year round, continuous basis.

Q. PLEASE DESCRIBE THE COMPANY'S STEAM PRODUCTION FACILITIES.

A. The system has three steam production facilities. The Denver Steam Plant

("DSP") is located in the Central Platte Valley at the intersection of Wewatta and 19th Streets and is the district steam system's primary source of steam production. The Denver Steam Plant supplies approximately 70% of total annual steam supply, and its two package boilers are capable of supplying a total of 260,000 pounds per hour ("pph"), or 260 Mlbs, to the system. Attachment No. TMF-5 shows an aerial view of the current Denver Steam Plant facility.

Zuni Station is located at 13th Avenue and Zuni Street, and supplies approximately 30 percent of total annual steam supply (including about 50 percent of peak system requirements), and can send up to 280,000 pph or 280 Mlbs to the system.

The State Steam Plant (also referred to as the Capitol Steam Plant) houses a smaller 120,000 pph or 120 Mlbs boiler. It is used primarily as a peaking plant, to guard against the loss of a unit at either of the other two primary steam generation locations, and to ensure system supply and reliability during normal distribution system maintenance outages. The State Steam Plant was commissioned in 2005 as a replacement for another Company boiler previously in service at the State Complex that had reached the end of its useful life. This plant can provide up to approximately 120 Mlbs of steam to the system, though currently its maximum output is limited to 80 Mlbs, because it is interconnected to a low pressure distribution system that cannot accommodate the full 120 Mlbs potential output of that boiler. Later in my testimony I discuss our plans to upgrade our system to allow us to operate this State Steam Plant boiler at its full 120 Mlbs capacity.

These three plants – the Denver Steam Plant, Zuni Station and the State Steam Plant – provide all of the steam for our district steam system. I will discuss the Zuni plant in some depth, as our need to retire this plant is a primary driver for this filing.

II. <u>THE ZUNI PLANT</u>

Q. PLEASE DESCRIBE THE ZUNI PLANT.

A. The Zuni Station is a critical component of Public Service's steam system, and includes two boilers, Unit 1A, which the Company placed into operation in 1950, and Unit 2, which the Company placed into operation in 1954. These two units were originally designed with electric generation capacity and the ability to export steam. Both units have now reached the end of their useful lives and Unit 1A was retired from electric service at the end of 2009. In Proceeding No. 12A-1264ST, the Company sought to replace Zuni Station's steam capacity with the proposed new Sun Valley Steam Center System. As a result of the decision in that docket rejecting a CPCN for Sun Valley Steam Center ("SVSC"), the Company now needs to keep Zuni Station in operation for steam generation until it can implement a long-term solution to replace the aging boilers at Zuni. Because our current steam system peak demand requires generation form all three of our existing plants, we will need to retain the Zuni plant for some time. However, the Company's recently completed Zuni Assessment (Attachment No. TMF-1) confirms that we cannot keep Zuni in operation indefinitely. The Company undertook this assessment of the Zuni plant equipment in order to identify critical issues that could impact continued operation of the Zuni Station boilers while in steam supply mode.

Q. PLEASE SUMMARIZE THE RESULTS OF THE ZUNI ASSESSMENT.

A. First, by way of background, the Company retired Zuni Unit 1A electric generation equipment at the end of 2009, and the Company's most recent resource plan proposes that we retire the Unit 2 electric generating equipment at the end of 2015. After that, the Company will not utilize the Zuni Plant for any electric generation, and the O&M costs and remaining book costs associated with continuing steam generation at Zuni will be borne entirely by the Denver District Steam. Mr. Scott Brockett discusses these issues in his testimony.

In terms of the physical condition of the Zuni Plant to continue steam operations, our assessment concluded that Unit 1A is in fair condition. With some modification/upgrades of critical support equipment, we believe the unit should be able to continue to operate reliably for the next three to five years, though risk of failure increases exponentially in the later part of that time window. These modifications include stack recoating, boiler refractory, condensate piping and feed water heater repairs, and an upgrade to the instruments and control systems. This unit has been operated regularly in support of steam operations in the past decade, and we are (relatively) confident that this unit can perform as needed, particularly in the earlier years of this 3-5 year period, once we complete these repairs and modifications. Unit 1A is the preferred unit for steam operations because its capacity is more closely matched with the overall send-out capability of Zuni Station, compared with Unit 2, which is a much larger unit and oversized for stand-alone steam requirements. While Unit 1A is better suited for continued steam production, we also determined that Unit 2 remains in fair condition. With modifications/upgrades of its critical support equipment, Unit 2 should be operable over the next three to five years. These modifications would involve the replacement of the boiler feed pump regulation control valve, discharge valve motor operators and check valves, a significant upgrade of the control system, increase in condensate transfer pump capacity, and piping modifications for steam-only operation. Unit 2, however, has had very limited operational use for steam over the past decade, and its larger size compared to the steam send-out capability at the plant would result in this unit operating at the low-end and thus lower efficiency range of its rated capacity.

For the Common areas, support system upgrades are necessary, which include replacing the instrument air compressor, upgrading water treatment equipment, roof repairs, and upgrading the sewer connection to bypass the evaporation ponds. These modifications would apply to the continued operation of either Unit 1A or Unit 2, but would support operation of both units.

Q. HAS PUBLIC SERVICE DETERMINED THAT ITS ZUNI PLANT IS AT THE END OF ITS USEFUL LIFE?

A. Yes. Energy Supply, which is the Public Service Department overseeing steam operations, has determined that Zuni is at the end of its useful life. The Zuni Assessment Report reinforces this conclusion, but with a caveat that with the modifications and upgrades recommend therein, the Company could likely continue to operate Zuni Station in steam production mode for a few more years.

Q. HOW HAS PUBLIC SERVICE BEEN ABLE TO CONTINUE TO OPERATE THE ZUNI PLANT EVEN THOUGH IT IS AT THE END OF ITS USEFUL LIFE?

A. The Company has continued to make some capital expenditures and incurred O&M expenses to keep Zuni running. This has kept Zuni Unit 1A operational for steam and Zuni Unit 2 operational for electric and steam as needed. There are clear indications, however, that reliability has deteriorated. Over the past two years, Zuni Unit 2 has had 5 failures, Zuni Unit 1A has had 7 failures, and there have been 4 failures related to the common equipment. Much of the equipment has reached the end of its normal service life at which time the potential for failure starts to increase exponentially with time.

Q. WHAT TYPES OF FAILURES HAVE OCCURRED ON THE UNITS?

A. The failures for Unit 2 have included extreme wear on the feedwater regulation valve, failure of the boiler feed pump discharge valve operator which led to the catastrophic failure of the pump motor, tube leaks found within the boiler during the assessment, bearing failure on the circulating water pump, and control system trips. The failures and necessary repairs for Unit 1A have included tube leaks and missing refractory found during boiler inspection, feed pump and turbine driver rebuilds to correct bearing problems, repair of leaks in the condensate piping to the deaerator, concrete falling from the stack, and control system trips. Common support system failures have included numerous roof leaks impacting storage and electrical areas, piping and equipment drain leaks, and leaking gas pipes on the exterior of the structure. Further, due to the age of the system, the availability of spare parts for the control systems is an ongoing concern. Eventually, we will not be able to source replacement parts. The age of the equipment, along with the continued use of the Zuni units, means that the frequency of failures will continue to increase over time, impacting the overall reliability of the system. Our plan is to make required repairs and investments that will allow us to keep Zuni Station operational for steam production in the short-term, but the longer we push Zuni beyond its useful life, the greater the risk of significant plant failure. Further, that risk is not linear, but increases exponentially over time, meaning that the risk of significant plant failure is significantly greater in year five as opposed to year one of our short-term plan to keep Zuni in service for 3-5 more years.

Q. EXPLAIN WHAT YOU MEAN WITH REGARD TO THE POTENTIAL FOR FAILURE INCREASING EXPONENTIALLY WITH TIME IN SERVICE BEYOND A PLANTS' SPECIFIED USEFUL LIFE?

A. Plant equipment has a "Service Life", which is the expected life of the equipment and is also used in many cases as the period over which the cost of the equipment is depreciated. Equipment, as with living beings, has a life cycle (service life). Toward the end of the equipment's service life the potential for failure increases exponentially. The report "2006 Replacements, Units, Service Lives, Factors, U.S. Department of Energy Western Area

Power Administration, U.S. Department of Interior Bureau of Reclamation, Denver CO May 2006" discusses the service life of plant equipment.

Q. WHAT WERE THE RECOMMENDATIONS FROM ENGINEERING AS A RESULT OF ITS CONCLUSIONS IN THE ZUNI ASSESSMENT REPORT?

A. For the short-term, the next three to five years, our Engineering Department recommends the continued operation of both of the boilers at Zuni Station to provide peaking steam capacity and backup steam capacity for the district steam system.

Q. IS THE COMPANY PROPOSING TO FOLLOW THE RECOMMENDATION TO UPGRADE BOTH UNITS AT ZUNI?

A. Not entirely. The Company has decided to undertake only the upgrades on boiler 1A in order to meet the interim needs of the steam business, due to concerns over the cost to customers to upgrade both units. We will use Unit 2 as a backup boiler and we will only replace equipment that has failed. This plan allows us to keep boiler 1A as our primary operating unit for peaking and backup, and boiler 2 as a backup if boiler 1A has a forced outage. By proceeding in this fashion we have tried to strike a balance between providing a limited level of redundancy and minimizing costs.

III. STEAM SUPPLY OPTIONS

Q. PLEASE SUMMARIZE THE CURRENT SYSTEM CAPACITY AND HOW STEAM DEMAND IS SERVED.

A. The two large Zuni plant boilers are capable of delivering up to 280 Mlb of steam to the distribution system using either boiler alone. There is a limitation on output capacity because of the tie line connecting the units to the steam distribution system. The Denver Steam Plant is typically operated to produce approximately 260 Mlb of steam supply, since this plant is usually controlled to keep the pressure in the distribution system constant. The Denver Steam Plant has a peak send-out capacity of 310 Mlb. The State Steam Plant, which unlike the other plants is only connected to our low-pressure distribution system, can typically satisfy 80 Mlb of low-pressure demand, but has capacity to produce 120 Mlb overall. If the State Steam Plant was connected to our intermediate-pressure system, the higher 120 Mlb send-out would be its capacity. Therefore, the total system capacity under peak winter operation has been:

Zuni Station	280 Mlb	One Boiler Operating
Denver Steam Plant	260 Mlb	Two Boilers Operating
State Steam Plant	80 Mlb	One Boiler Operating
Total Operational Capacity	620 Mlb	

The maximum historical demand of 500 Mlb to 550 Mlb sendout can be supplied even when the larger Denver Steam Plant unit is out of service, except for a few hours when winter loads are at their highest. During the summer period, each of the four largest boilers can provide the entire system capacity requirement of 60 Mlb to 80 Mlb, which allows the planned outage of each unit for annual maintenance to be performed in an efficient manner on a predictable schedule.

Q. HOW DOES THE COMPANY PLAN TO HANDLE THE CONTINUING STEAM LOAD SINCE THE SUN VALLEY STEAM CENTER CPCN WAS DENIED?

A. As I previously indicated, the company had planned to retire Zuni Station in its entirety at the end of 2015 due to its age, high operating cost, safety concerns about operating old outdated equipment, and the high cost to maintain the equipment in a reliable condition. Based on the denial of the Company's Application to replace Zuni with the Sun Valley Steam Center, we determined that the best solution to continue providing reliable steam service in the short-term is to continue to operate the Zuni station. We also evaluated numerous alternatives to continue to meet customer demand in the long term.

Q: WHAT SHORT-TERM SOLUTIONS DOES THE COMPANY PLAN TO IMPLEMENT TO BE ABLE TO PROVIDE RELIABLE STEAM SERVICE IN THE SHORT TERM (THE NEXT 3-5 YEARS)?

A. For the short-term, our interim plan is to keep Zuni running by investing in capital improvements as Mr. Brockett discusses in more detail in his testimony. In addition, as I describe later, we also plan to upgrade our State Steam Plant to intermediate-pressure, which we project will result in 40 Mlb of effective production capacity gains. While the plan to continue to operate

Zuni is truly short-term, and we plan to fully retire Zuni from steam production as soon as possible, the State Steam Plant upgrade to intermediate-pressure will result in a permanent system efficiency gain. Once the State Steam Plant is connected to the intermediate-pressure system, it has the capacity and capability of supplying the entire system's summer load. After its upgrade the State Steam Plant would be operated during the summer instead of Zuni to enhance system efficiency and reliability. This approach would reduce our dependence on Zuni and reduce its potential for equipment failure.

Q. WHAT LONG-TERM SOLUTIONS HAS THE COMPANY CONSIDERED AND EVALUATED TO CONTINUE TO PROVIDE RELIABLE STEAM SERVICE?

A. The Company considered a large number of options to supply steam in the future to its customers. We began broadly, by considering an array of options, and then distilled this initial list to eleven options, based on feasibility. We then evaluated those eleven long-term supply side options in greater detail, as demonstrated in Confidential Attachment No. TMF-2A, the "Steam Supply Options Report."

Q. CAN YOU PROVIDE AN EXAMPLE OF A PROJECT THAT WAS REJECTED AT THE PRELIMINARY FEASIBILITY STAGE SUCH THAT IT WAS NOT INCLUDED IN THE FINAL MATRIX OF THE ELEVEN OPTIONS CONSIDERED?

A. Yes. One option that we considered but rejected at the preliminary, feasibility stage was a combined heat and power ("CHP") supply side solution. The

Company has studied this option extensively in the past, but CHP is not an ideal solution because the capital construction costs for CHP units are significantly higher than for steam package boilers. In addition, CHP is not well-tailored to meet our respective steam and electric supply side requirements. When we most need increased steam output—during winter peaks—electric demand is typically relatively light. When we most need electric generation to meet summer peak demand during hot days, there is very little steam demand.

Q. HAS THE COMPANY SPECIFICALLY EVALUATED CHP SERVICE SOLUTIONS IN THE PAST?

A. Yes. For instance, in response to a 2009 all-source competitive solicitation we reviewed a proposal for a 40 MW Combined Heat and Power facility to be located at Zuni Station. It was not an economically feasible alternative at that time. The Company again reviewed CHP projects in 2011 in association with a screening analysis on options for replacing the existing boilers at Zuni. This analysis included CHP options as well as a new package boiler option. The Electric Resource Plan ("ERP") cost of the package boiler plant was $28,689,000, versus $61,277,000 for the best potential CHP alternative, which would require two Siemens SGT 500 gas-combustion turbines with heat steam recovery generators and an electric output of 25 MW net. As was true for the CHP proposal submitted in response to the 2009 All-Source electric bid process, the CHP alternative was simply not competitive from a cost perspective, compared against the cost of constructing a new package boiler. The results of this analysis led us to the development of a package boiler plant.

Q. WHY DIDN'T CHP PASS THE FEASIBILITY STEP HERE?

A. As was true in 2009 and 2011, the CHP option just didn't make sense from a cost perspective, either for steam production or electric generation. For instance, the CHP option submitted in response to the 2009 All Source bid process would have utilized two simple cycle gas turbines with heat recovery. This design required the unit to be dispatched to meet steam system load demands. Even though the plant was capable of 40 MW net electric output, that output could only be obtained when the steam demand was at least 280 Mlb/hour or greater. The electric and steam generation by the facility are proportional; as electric generation increases, steam generation increases to a maximum net electric output of 40 MW with a corresponding steam output of 280 Mlb/hour. As the steam demand goes below 280 Mlb/hour, the electric output would decline to a minimum load of approximately 9 MW. This is approximately equivalent to the average summer load the unit would be supplying during the summer due to the reduced steam demand by the Thermal Energy system.

Q. CAN YOU FURTHER DESCRIBE THE ANALYSIS THAT DETERMINED THAT CHP WAS TOO EXPENSIVE?

A. The Zuni CHP proposal from the 2009 All-Source competitive solicitation process was analyzed against the other options submitted. The all-in cost of energy from the proposed CHP Zuni facility was between 25% and 35%

higher than the bid price offered by IPPs with existing combined cycle gas-fired generators.

Q. BEFORE DISCUSSING SPECIFIC OPTIONS, WOULD YOU LIKE TO ADDRESS ANY LIMIATIONS REGARDING STEAM BOILERS THAT ARE RELEVANT TO THE SELECTION PROCESS?

A. Yes. Although we would like to deploy specific steam peaking units, similar to the peaking units we use in our electric business, there is simply no such option for steam. An electric generation portfolio can comprise various technologies to most economically serve system loads of varying duration. For example, simple cycle units with relatively low- installed costs per KW but higher operating costs can be used as peaking plants to provide service for short periods when system loads are at their highest. In contrast, base load coal plants or combined cycle gas plants with relatively high installed costs per kW but relatively low operating costs can be used to serve system loads of longer duration. Unfortunately, there are no steam analogues to electric baseload and peaking units. In other words, there are not two types of steam production plant – one with high capital costs and low operating costs, and another with low capital costs and high operating costs. Consequently, our baseloads and peaking loads are served by the same steam generation fleet.

Q. PLEASE DESCRIBE EACH OF THE OPTIONS THAT WERE INCLUDED IN THE LONG-TERM STEAM SUPPLY SIDE ANALYSIS.

A. The Company evaluated numerous long-term steam supply options, each as a stand-alone option with varying contributions to the steam supply system, as detailed in Attachment No. TMF-2, and summarized below:

Option A As formerly proposed Sun Valley Steam Center – This new facility would be located adjacent to the existing Zuni plant, with two package boilers and auxiliary equipment, within a building that also contains office and storage/shop space capable of supporting the entire Steam System operations group. It would replace the Zuni plant with an equivalent capacity and better efficiency.

Option B Reduced Scope Sun Valley Steam Center - This option is the same as Option A, except for a reduction in office and support space of about 50%.

Option C – Two New Package Boilers in the Existing Zuni Building - In an attempt to reduce the cost by eliminating the new Sun Valley building, the two new package boilers with economizers would be installed along with new auxiliary equipment in the existing Zuni turbine building, and some of the existing Zuni auxiliary systems would be reused with modifications as necessary. Both existing Zuni boilers would eventually be decommissioned.

Option D – One New Package Boiler in Existing Zuni Building - This option includes half the new equipment in Option C above within the existing Zuni building.

Option E – Major Upgrade of Zuni Unit 1A Boiler for Reliable Long-Term Operation - This option does not involve the addition of any new boiler capacity, but it does involve significant capital modifications and incremental annual O&M investments necessary for the continued operation of Zuni Boiler

1A for another 30 years. Given the age of the Zuni boilers, this option is equivalent to essentially fully renewing or replacing Zuni, which is more expensive than constructing a brand new facility.

Option F – Major Upgrade of Zuni Unit 2 Boiler for Reliable Long-Term Operation - Similar to Option E in terms of the modifications and annual investment for Unit 2, except for the stack. Again, this represents an option that fully replaces and renews Zuni.

Option G – One New Package Boiler at Cherokee Steam Plant owned by the City of Denver - This Option assumes that a new package boiler and auxiliary equipment and systems would be installed in the historic Cherokee Steam Plant building (on Cherokee Street near 13th Avenue), which still contains the retired City of Denver equipment of the former plant. Note that this option would be applicable to other locations as well – if available – within the Company's steam footprint. We use the Cherokee plant in this example as a generic representation of similar equipment at non-Company owned sites. Other potential sites have been investigated by our siting and land rights department as detailed in Company Witness Mr. Steve Kutska' s Direct Testimony.

Option H – Two or more Used Package Boilers in Existing Zuni Building - This option is similar to Option C (two new boilers at Zuni) above, with the exception that the characteristics of the used boilers will determine the type and capacity of the support systems.

Option I – Take over Operation of Non Company-Owned Boilers and tie into the intermediate-pressure steam system - This Option would involve the addition of 80 Mlb of new winter send-out capacity to the intermediate-pressure system. It would require Public Service to lease the three existing boilers and associated support equipment at a large hotel, and take over operating responsibility for the boiler systems. This facility would supply both the Hotel's native load as well as provide and manage excess send-out to meet district steam system requirements. While initially included in options for financial analysis, this option was deemed to have insufficient information for the financial screening because the costs were too uncertain. Hence we eliminated this option from further consideration after the feasibility stage. With additional time and a budget, the Company could get data of sufficient quality to include it in an analysis, but given the time and resource constraints along with limited documentation and information and thus uncertainty about the equipment (older boilers built in 1957 located in the sub-basement of a high rise building), we decided to eliminate this option from further consideration.

Option J – One New Package Boiler at Denver Steam Plant - This Option would involve the addition of a new package boiler and necessary support equipment to supplement the existing two boilers at Denver Steam Plant.

Option K – Tie State Boiler into Intermediate Pressure ("IP") Steam System - This Option would involve the reconfiguration of the State Steam Plant send-out connection and associated valves, along with modifications to the nearby distribution piping, from the Low Pressure ("LP") to the IP system. This would allow the existing 120 Mlb boiler to deliver all of its 120 Mlb capacity to the steam supply system, rather than its current 80 Mlb due to the limitations of the LP system. As indicated, the Company plans to proceed with this option as part of its short-term solution, and this option is also included as part of our long-term supply side solution because, once implemented, it will be a permanent enhancement to our steam system.

Q. HOW WERE THE OPTIONS EVALUATED?

A. I more fully described Options A and B in detail in my Direct Testimony in Proceeding No. 12A-1264ST. These options were developed in significant detail; including drawings, detailed cost estimates & schedules, and send-out capacity. Using this information as a template, each of the other options was evaluated on the same basis, but with less detail, and without new drawings. The capital and O&M cost estimates were a factor of those developed in the prior filing along with representative schedules and estimated send-out capacity. The confidential cost estimates are presented in Confidential Attachment No. TMF-3A for capital costs and Confidential Attachment No. TMF-4A for O&M estimates. These documents are considered confidential because the selected option will be sent out for proposals once approved. Based on the capital and O&M cost estimates, we completed a preliminary financial analysis in order to screen and rank each option in terms of its assessed net present value of total lifecycle costs. The lifecycle costs are inclusive of ongoing capital and O&M expenses for each of the options. The financial ranking process and analysis is described in more detail in Confidential Attachment No. TMF-2. The Company's Generation Asset Analysis and Reliability group performed this analysis and ranking. In addition to the financial assessment, the Company considered the amount of added capacity each option would add to the steam system. The results of the financial screening rankings are presented in Table 7-1 of the Steam Supply Options Report, Confidential Attachment No. TMF-2. We also assessed the level of confidence in the cost estimates, along with the level of steam supply reliability for each option. The analysis on options A and B are recent enough so that they do not need to be refreshed, we did include escalation to bring the cost to 2014 dollars.

Q. WERE THERE ANY ADDITIONAL ALTERNATIVES STUDIED BEYOND THOSE THAT YOU HAVE DESCRIBED?

A. No. We made an inclusive and thorough attempt to identify all of the practical options in our study.

Q. WHAT SHORT-TERM OPTIONS IS THE COMPANY PROPOSING TO PURSUE?

A. We are proposing an interim strategy that will allow the Company to maintain the existing system capacity until we can better identify the long term steam load. Our policy reasons for our stepped approach are described in detail by Mr. Brockett. As I previously describe, the interim option we propose is to make capital and O&M improvements to the Zuni boiler Unit 1A to maintain it in reasonable operating condition, and to keep Zuni boiler Unit 2 as a backup until the final long-term solution is in place. No anticipated investments will be made on Unit 2, but once the unit is retired from electric generation, we will keep the equipment necessary to generate steam in place.

In addition, we also recommend proceeding with the State Steam Plant upgrade to the intermediate-pressure distribution system. Upgrading the State Steam Plant to intermediate-pressure will be beneficial in both the short-term and long-term. Once we complete this upgrade, we can minimize our dependence on Zuni, a unit with questionable reliability, with the exception of the winter months when Zuni must be available to support steam peak operations. An additional benefit of the State Steam Plant upgrade is that it will allow the Company to operate a more efficient, relatively new unit when needed. It can handle most if not all of the summer load when the Denver Steam Plant is out of service for annual maintenance, thus minimizing the need to rely heavily upon Zuni.

Q. WHAT LONG TERM SUPPLY OPTIONS ARE YOU RECOMMENDING?

A. After we better understand the new demand profile for the steam system as described by Company witness Scott Brockett, we will determine which long term service solution best matches our anticipated future supply obligations. Engineering is recommending three potential solutions, each of which corresponds to a specific range of long-term system peak loads.

If the system demand peak is approximately the same as or greater than current system peak demand, then two new package boilers will be needed. The preferred resource is then Option B, the Reduced Scope Sun Valley Steam Center, which I previously discussed.

If future steam demand is not high enough to require two new boilers, but is greater than what can be supplied by DSP and SSP alone, then we would add one additional boiler at the Denver Steam Plant (Option J discussed above).

If future system demand peak declines sufficiently to be served reliably by the existing Denver Steam Plant plus the upgraded State Steam Plant then no additional boilers will be required. Under this scenario these two existing plants will serve the long-term needs of the system.

The preferred resources described above were selected based on our analysis of the life-cycle cost of each option for each capacity range. Mr. Kutska and Mr. Brockett explain how the Company will select the best long-term option from the three options identified above.

Q. WHY ARE YOU PROPOSING TO STRUCTURE THE POTENTIAL REPLACEMENT OF ZUNI IN TWO STEPS, AS AN INTERIM OPTION PLUS A LONG-TERM OPTION?

A. In order to continue to provide reliable steam to our existing customers, the Company will have to keep Zuni Station operating in the short-term, or until we can implement our long-term solution. In my opinion we have no viable short-term alternative. Continuing to run Zuni after completing the necessary modifications and repairs is the most cost-effective approach in the short run, even though it is not ideal because of the reliability concerns I addressed previously, and discussed in detail in the Zuni Plant Assessment Report (Attachment No. TMF-1). These concerns are mitigated somewhat by the added operational flexibility of the upgrade to the State Steam Plant and its associated higher reliability.

Q. WHY DOES THE LONG-TERM OPTION HAVE TO BE APPROVED NOW, CAN'T THE COMPANY WAIT UNTIL IT KNOWS THE REQUIRED PRODUCTION CAPACITY REQUIREMENT?

A. The timing for installing new production capacity is critical because of the reliability risks that I have already discussed with respect to Zuni. There is sufficient uncertainty surrounding the continued operation of Zuni even after the upgrades that having the production capacity in service now is preferred to maintain system reliability. Furthermore, if the Company does not need two new boilers, the Zuni site could conceivably be freed up for the redevelopment as described by Mr. Brockett.

IV. PROJECT DESCRIPTIONS

Q. WHAT INFORMATION ARE YOU PROVIDING IN SUPPORT OF THESE PROJECTS?

A. Consistent with the CPUC rules for a CPCN as outlined in the Application, I am providing the information that the Company has developed to request a CPCN for the long-term options.

A. Short-Term Projects

Q. WHAT PROJECTS WILL THE COMPANY UNDERTAKE TO ENSURE THAT IT CAN MEET CUSTOMER DEMAND IN THE SHORT-TERM?

A. It is my understanding that the Company is requesting CPCN approval for our two long-term options related to the construction of new facilities, but not for the short-term options. I am providing information to address all of the projects, even though some may not require specific CPCN approval. As I described earlier in my testimony, the Company will undertake needed modifications and repairs to allow Zuni Station to remain in operation for steam production over the next 3-5 years. In addition, we will modify our facilities at the State Steam Plant to allow it to interconnect with our distribution system at intermediate-pressure, rather than low-pressure. This will add the equivalent of 40 Mlbs. of additional capacity to our system. Note that, while we include the upgrade of the State Steam Plant to intermediate-pressure as part of our short-term planning, this upgrade will be permanent, and will also marginally increase our output capacity in the long-term.

1. Modifications To Zuni Unit 1A For Continued Short-Term Operation

Q. PLEASE DESCRIBE THE PROPOSED MODIFICATIONS THAT WILL ALLOW ZUNI UNIT 1A TO CONTINUE TO RUN TO SUPPORT STEAM OPERATIONS FOR THE NEXT 3-5 YEARS?

A. As I stated earlier, the Company plans to undertake critical modifications and repairs to the Unit 1A equipment identified during the recently completed Zuni Assessment. These modifications include stack recoating, additional roof repairs, boiler refractory, feed water heater, condensate piping repairs, an upgraded sewer connection for blowdown that can no longer be sent to the on-site evaporation ponds, and a significant upgrade to the instruments and control systems. This project will extend the life for Zuni Unit 1A.

Q. HAS THE COMPANY PREPARED ANY DRAWINGS OR RENDERINGS OF THE PROPOSED MODIFICATIONS TO THE ZUNI STEAM PLANT?

A. No, the modifications will not be visible outside the existing buildings, and will not significantly change the current equipment layout at the Zuni Plant.

Q. WHAT IS THE ESTIMATED CAPITAL COST FOR THESE MODIFICATIONS?

A. The total capital expenditures are detailed in Confidential Attachment No. TMF-3. These expenditures will occur over an 11-month period starting in January 2016 and finishing in November 2016. The in-service date for these upgrades is approximately October 11, 2016.

Q. WHAT ARE THE ESTIMATED OPERATIONS & MAINTENANCE COSTS FOR THIS ZUNI STEAM PLANT UPGRADE?

A. The O&M costs for the upgrade are provided in Confidential Attachment No. TMF-4 under option Z1. In general, the annual O&M increases from current costs are primarily driven by the retirement of Zuni for electric operations and the resulting transfer of all O&M costs to the steam department.

Q. HOW WERE THE O&M COSTS DEVELOPED?

A. The O&M costs were developed by steam operations personnel as described by Mr. Kutska.

Q. WHAT IS THE PROPOSED SCHEDULE FOR THE MODIFICATIONS TO THE ZUNI STEAM PLANT?

A. Since the Zuni Steam Plant must continue to be available as a backup to the other supply plants during the winter months, the proposed modifications will be scheduled to avoid outages during peak demands on the steam system. We will schedule the modifications for the summer of 2016, when Unit 1A can be taken off line for several weeks at a time and while Zuni Unit 2 equipment is still available. A high level schedule for these modifications is shown in Attachment No. TMF-6. The timing of the State Steam Plant reconfiguration to the intermediate-pressure system may also affect the Zuni modification schedule.

2. Reconfiguration of State Steam Plant Interconnection to the Intermediate-Pressure Distribution System

Q. HOW WILL THE COMPANY RECONFIGURE THE STATE STEAM PLANT TO MAKE IT COMPATIBLE WITH THE INTERMEDIATE-PRESSURE DISTRIBUTION SYSTEM?

A. This project involves reconfiguring the steam send-out connection and associated valves from the low-pressure to the intermediate-pressure system for the State Steam Plant. In addition to the modifications within our steam supply plant, we will also need to modify customer equipment for customers whose distribution system site is located between the State Steam Plant and the nearest intermediate-pressure distribution header. Once this upgrade is complete, it will allow the existing 120 Mlb boiler to run at full capacity, rather than its current limit at 80 Mlb, the maximum pressure at which we can operate this boiler to provide steam to low-pressure system customers. The boiler support systems at this facility are currently capable of supporting the higher operating pressure, so no major modifications will be needed there. The State Steam Plant boiler is the newest boiler on the system having been placed into service in 2005, so upgrades at this plant will allow the State Steam Plant to continue to run well into the future without any additional significant ongoing capital expenditures. Another significant advantage of this option is that it will allow the State boiler to supply the entire steam demand during the summer Denver Steam Plant maintenance outage, not just low-pressure customer demand, as is currently the case. This will also allow the State Steam Plant to run more and Zuni to run fewer hours. In addition, the

State Steam Plant boiler is much newer and more efficient than the 1950s-vintage Zuni boilers, which will result in lower O&M expenses overall.

Q. AFTER THE COMPANY COMPLETES THE MODIFICATIONS TO ALLOW THE STATE STEAM PLANT TO PROVIDE STEAM AT INTERMEDIATE PRESSURE, WILL ANY CUSTOMERS STILL BE SERVED BY STEAM PROVIDED AT LOW-PRESSURE?

A. Yes. The bulk of the low-pressure system will still exist with several steam customers continuing to be served from the low pressure system. The modifications will allow the State Steam Plant to supply steam to *all* customers; which includes both intermediate-pressure and low-pressure customers. This will allow us to run our overall steam operations more efficiently.

Q. WHERE WILL THE COMPANY NEED TO MODIFY ITS DISTRIBUTION SYSTEM IN ORDER TO UPGRADE THE STATE STEAM PLANT TO INTERMEDIATE-PRESSURE?

A. The State Plant is located on Sherman Street, between 13th and 14th Avenues in downtown Denver. The nearest connection to the intermediate-pressure distribution system is located near the intersection of Glenarm Street and 15th Street, and we will need to upgrade a number of customer valves along this route to complete this project.

Q. HAS THE COMPANY PREPARED ANY DRAWINGS OR RENDERINGS OF THE PROPOSED MODIFICATIONS TO THE STATE STEAM PLANT?

A. There are no drawings or renderings at present – no drawings are currently required in order to proceed with the upgrade. The modifications affect a number of customers, and are specific to the existing piping systems. We do have a map of the State Steam Plant ("SSP") location provided in Attachment No. TMF-7, as well as an aerial photo in Attachment No. TMF-8.

Q. WHAT ARE THE ESTIMATED CAPITAL COSTS TO UPGRADE THE STATE STEAM PLANT SYSTEM?

A. The total capital expenditures are detailed in Confidential Attachment No. TMF-3, this spending will occur over a 21-month period starting in March 2015 and finishing in November 2016. The expected in-service date for this upgrade is October 31, 2016.

Q. WHAT ARE THE ESTIMATED OPERATIONS AND MAINTENANCE COSTS FOR THIS PROJECT?

A. The upgrade has no impact on our fixed O&M costs. The net variable O&M would go down with the increased operation of the State Plant because of the improved operating efficiency over Zuni. These costs are provided in Confidential Attachment No. TMF-4 under option K.

Q. HOW WERE THE O&M COSTS DEVELOPED?

A. The O&M costs were developed by steam operations personnel, as described by Mr. Kutska.

Q. WHAT IS THE PROPOSED SCHEDULE FOR THE RECONFIGURED STATE STEAM PLANT PROJECT?

A. The lead time for materials is relatively short, and we expect to be able to complete the upgrade installation over two 4-month summer periods in 2015 and 2016 when individual customers can be isolated for a few days without any major problems. Attachment No. TMF-9 shows a high-level schedule for the Reconfigured State Steam Plant project, based on an in-service date requirement of October 31, 2016.

B. <u>Long-Term Alternative Projects</u>

Q. WHY DO YOU DESCRIBE THESE AS LONG-TERM "ALTERNATIVE" PROJECTS

A. These are "alternative" projects because the Company does not yet know which of these capital projects, if any, it will undertake to meet long-term demand. As Mr. Brockett discusses in more detail, depending on the Company's assessment of likely future demand on the steam system, the Company will install no additional boilers (zero boiler), one new boiler (DSP Expansion), or two new boilers (Reduced Scope SVSC). I provide CPCN detail for the one boiler and two boiler construction scenarios. Note that even under the "no build" scenario, our modifications to the State Steam Plant to allow it to operate at intermediate-pressure will be a permanent upgrade to the send-out capacity of that plant. If we do determine that we need additional capacity to replace Zuni's steam generation capability, we will add either a single boiler or two boilers to our generation fleet. I describe the one-boiler and two-boiler options below.

1. Expanded Denver Steam Plant/One-Boiler Option

Q. PLEASE DESCRIBE THE EXPANDED DENVER STEAM PLANT PROJECT.

A. This project would consist of adding a new package boiler and associated auxiliary equipment at the Denver Steam Plant, so that there would be three boilers in service. The Denver Steam Plant building would be expanded to add approximately 40-50% more floor space. We would need to interconnect the new equipment with the existing services for water, natural gas, #2 fuel oil, steam send-out, sewer, electrical and controls. The new boiler would be the same size as the larger existing boiler with a send-out capacity of 160 Mlb. It would also have to be equipped with an economizer. There are two steam distribution headers connected to the Denver Steam Plant facility, and together they would be capable of receiving the maximum steam generation output from all three boilers combined. To expand the site buildings, we would also need to remove an existing underground oil tank (designed for #6 fuel oil and currently decommissioned). The existing boilers now use #2 oil as a backup fuel, and the new boiler would also be designed for natural gas as the primary fuel with #2 oil as a backup fuel, using the existing buried #2 oil tank. We would also need to install a new stack serving the new boiler; the height of this new stack would be dependent on air modeling studies. The current drive-through corridor for deliveries of fuel oil and chemicals to the plant would be retained.

Q. HAS THE COMPANY PREPARED ANY DRAWINGS OR RENDERINGS OF THE PROPOSED EXPANDED DENVER STEAM PLANT?

A. Several possible layout options for the new equipment at Denver Steam Plant are currently under consideration. A representative layout of the new equipment and expanded building is provided as Attachment No. TMF-10. A marked-up aerial view of the same layout is provided as Attachment No. TMF-5. The final layout will be determined during the design phase of the project, which will be completed during the fourth quarter of 2015 if the Company elects to proceed with this long-term supply side option.

Q. WHAT IS THE ESTIMATED CAPITAL COST FOR THE DENVER STEAM PLANT ADDITIONAL BOILER?

A. The total capital expenditures are detailed in Confidential Attachment No. TMF-3A. These expenditures will occur over a three-year period starting in August 2015 and finishing in December 2018. The in-service date is October 1, 2018. Confidential Attachment TMF-3A, option J, provides additional detail on how the Company determined these costs.

Q. WHAT ARE THE ESTIMATED OPERATIONS & MAINTENANCE COSTS FOR THIS PROJECT?

A. The O&M costs for the upgrade are provided in Confidential Attachment No. TMF-4A under option J. In general, this project would decrease the Company’s annual O&M costs -- primarily driven by the reduction in labor costs.

Q. HOW WERE THE O&M COSTS DEVELOPED?

A. The O&M costs were developed by steam operations personnel, as detailed by Mr. Kutska.

Q. WHAT IS THE PROPOSED SCHEDULE FOR THE EXPANDED DENVER STEAM PLANT PROJECT?

A. Attachment No. TMF-11 shows a high-level schedule for the Expanded Denver Steam Plant development project, based on an in-service date requirement of September 30, 2018.

2. 2-Boilers: Reduced Scope Sun Valley Steam Center

Q. PLEASE DESCRIBE THE PROJECT?

The Reduced Scope Sun Valley Steam Center proposal is a project to construct and install a steam generation facility, which consists of two new package boilers and supporting equipment, including water treatment facilities, a boiler feedwater system, control system, electrical equipment and a building to house the equipment. The building will also house the operating, maintenance, and management personnel who will operate and maintain the steam boiler plant and manage the facility. This system is designed to replace Zuni Station's steam generation send-out capacity. The new plant will consist of state-of-the-art and highly efficient equipment, which will minimize plant emissions and meet or exceed current emission requirements. The approximately 280 Mlb/hour of new send-out capacity will be sufficient to replace the capacity currently provided by Zuni Station. The new package boiler plant will be designed to be very efficient in its use of natural gas, water, and electric power for steam production. The facility will be automated to the extent practical to minimize personnel for operations and maintenance. The plant will be designed and equipment selected to ensure reliability and to minimize operation and maintenance costs. The new steam production facility would be a long-term and cost-effective solution for the replacement of the steam capacity currently being provided by Zuni Station if customer demand proved to be high enough to justify two new boilers.

Q. WHERE WOULD THE REDUCED SCOPE SUN VALLEY STEAM CENTER BE LOCATED?

A. The reduced scope Sun Valley Steam Center would be located at the site of the former coal yard at Zuni Station. An aerial photograph of the proposed site location is attached hereto as Attachment No. No. TMF-12 and a Site Map and photo of the proposed site are attached as Attachment No. TMF-13.

Q. HAS THE COMPANY PREPARED ANY DRAWINGS OR RENDERINGS OF THE PROPOSED REDUCED SCOPE SUN VALLEY STEAM CENTER?

A. Yes, we have prepared preliminary design documents. We generated these documents during the preliminary design phase of the project to develop a better understanding of the facility and its land and building requirements, and to develop a more accurate cost estimate. I have included as Attachment No. TMF-14 a rendering of the proposed Sun Valley Steam Center building and a drawing of the general arrangement of the plant equipment. Attachment No. TMF-15, entitled “Mechanical Equipment Layout,” shows the general arrangement of the boiler plant equipment on the ground floor of the Sun Valley Steam Center.

Q. WHAT IS THE ESTIMATED CAPITAL COST FOR THE REDUCED SCOPE SUN VALLEY STEAM CENTER?

A. The total capital expenditures are detailed in Confidential Attachment No. TMF-3A. These expenditures will occur over a three-year period starting in August 2015 and finishing in December 2018. The in-service date is October 1, 2018. Confidential Attachment No. TMF-3A provides additional detail on how the Company determined these costs.

Q. WHAT ARE THE ESTIMATED OPERATIONS & MAINTENANCE COSTS FOR THIS UPGRADE?

A. The O&M costs for the upgrade are provided in Confidential Attachment No. TMF-4A. In general, the project would reduce the Company's annual O&M costs -- primarily driven by the difference in labor costs between running Zuni and running the SVSC, as well as the reduction in variable O&M costs due to the higher efficiency of the SVSC.

Q. HOW WERE THE O&M COSTS DEVELOPED?

A. The O&M costs were developed by steam operations personnel, as discussed by Mr. Kutska.

Q. WHAT IS THE PROPOSED SCHEDULE FOR THE REDUCED SCOPE SUN VALLEY STEAM CENTER PROJECT?

A. The preliminary project schedule prepared for the Reduced Scope Sun Valley Steam Center is provided in Attachment No. TMF-16. It is based on an in-service requirement date of September 30, 2018.

Q. DOES THIS CONCLUDE YOUR TESTIMONY AT THIS TIME?

A. Yes.

ATTACHMENT A

Tim M. Farmer

Statement of Qualifications

I am currently Xcel Energy's Manager of Engineering for the Denver Engineering and Construction Group. Prior to this position, I was the Comanche Project Director for the 750 MW supercritical coal-fired electric power plant that was built at Comanche Station in Pueblo, Colorado, and had been actively involved in the Comanche 3 project for over five years. I have a BSME degree from New Mexico State University and I am a registered professional engineer in the state of Colorado. I have been active as an engineer and project manager in the power generation field since 1981.

I was the Xcel Energy project manager for the design and construction of a district cooling plant and distribution system for Xcel Energy in downtown Denver, engineering project manager for Utility Engineering (UE) on the South Point Calpine Energy 500MW combined cycle power project, and engineering project manager for UE on the Front Range Power Project for Colorado Springs Utility, a 500MW combined cycle plant that included the state's largest air-cooled condenser. I joined Xcel Energy's Engineering and Construction department in April 2005 as one of UE's employees that transferred over during the third-party acquisition of UE. Between 1981 and 1995, I was actively involved in the design and construction of modifications/upgrades to Xcel Energy's steam utility distribution system.

Zuni Units 1A and 2

Equipment Assessment

And Preliminary Review of Other Steam Generation Options

Prepared by: Tim Farmer
Mark Steckman
Jack Darnell
Zuni Plant Personnel

Date: August 18, 2014

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Zuni Units 1A and 2 Equipment Assessment

Executive Summary

The purpose of the Zuni assessment study is to determine the current condition of the steam generation equipment at Zuni Station, and what would be required to keep the plant operating in steam-only mode for at least the next 5 years, as well as longer-term, into the future. The original report focused on the assessment of Unit 2. More recent investigation now allows this revision to cover the condition of both Unit 1A and 2 steam generating equipment.

This two phase approach was required because Unit 2 equipment was not needed and was off line in the spring of 2014, which allowed equipment inspections that supported the original report in March 2014. In the past few months, Unit 1A boiler has been taken off line, except for a period to support steam supply during the planned DSP outage, and that allowed a similar set of equipment inspections to be carried out for the Unit 1A steam generation equipment.

Zuni Station is a critical component of the Denver Steam Heat System. With the peak system steam demand in the range of 500,000 to 550,000 pph, steam generation from the Zuni plant up to its sendout limit of 280,000 pph is required to meet peak and backup steam requirements for the system. With the PUC rejection of a CPCN for a replacement steam generation plant, Zuni is required to stay in operation to support the Denver Steam Heat System indefinitely, or until another option is developed to serve this purpose. While studying the additional investments Xcel Energy needs to perform air monitoring studies at each site. Monitoring can take up to 18 months.

Zuni Unit 1A electric generation equipment was retired in January of 2010, and Unit 2 electric generating equipment is scheduled for retirement at the end of 2015. After that, the O&M costs and remaining book costs that are associated with continuing steam generation at Zuni will transfer entirely over to the Denver Steam Heat System Business. These costs will have a rate impact to the steam customers, as will a proposed rate system adjustment to include a demand charge. The impact to in the total system demand based on these changes has yet to be determined.

Unit 1A is in fair condition, and with some modification/upgrades of critical support equipment, the unit should be able to continue to operate into the near future. These modifications include stack recoating, boiler refractory and feed water heater repairs, and a significant upgrade to the control systems. This unit has been operated regularly in support of steam operations in the past decade, and there is higher confidence among the operators that this unit can perform as needed. Its size is also better matched to the sendout capacity of the station.

Unit 2 is also in fair condition, and with modifications/upgrades of critical support equipment, the unit should be able to continue to operate into the near future. These modifications would involve the replacement of the BFP regulation control valve, discharge valve motor operators and check valves, a significant upgrade of the control system, increase in condensate transfer pump capacity, and piping modifications for steam-only operation. This unit has had very limited operational experience over the past decade, and its size compared to the steam sendout capacity at the plant would cause it to operate at very low percentage of its rated capacity.

Common support system upgrades are recommended to include the installation of the instrument air compressor from Arapahoe station, upgraded water treatment equipment, routine building roof repairs, and an upgraded sewer connection to replace the use of the evaporation ponds. These modifications would apply to the continued operation of either Unit 1A or Unit 2, but can support both units operating.

Due to the age of the equipment at Zuni, with most of the equipment exceeding its normal service life, there is a high probability that a given piece of equipment could fail at any time. Recent boiler tube leaks on both units, several electrical-related outages at Zuni during the DSP planned outage, and the failure of one Unit 2 boiler feed pump and motor are examples of this reality. Current inspection records and information on the equipment do not indicate that we will have imminent equipment failures. Due to the high risk of critical equipment failure at Zuni, it is prudent that both Unit 2 and Unit 1A be kept as operating units for the steam heat system. Within the report, this is presented as Option 3.

B&W has estimated the investment required to make modifications to the Unit 2 and Unit 1A boilers to allow for longer-term, more reliable operation at the reduced load dictated by system demand and the steam line capacity. Additionally, much of the support equipment for boiler operation would need replacement to allow long term operation of the units. For the longer term steam supply needs, options other than continued operation of Zuni are likely to result in lower steam rates, due to expected high O&M and fuel costs associated with the very old equipment, especially with the potential of a lower steam demand after the rate changes are absorbed by the customers. Closure of Zuni gives Xcel the option of turning the site over to Denver for the Sun Valley redevelopment work.

For the short term, the next five years, we recommend the continued operation of Zuni Station for providing peaking steam capacity and backup steam capacity for the Denver Steam System. It is the low cost option for the short term that can supply the capacity needed. With Management approval, we will make the minimum-investment modifications necessary to operate both Unit 1A and Unit 2 in a steam-only mode. We recommend that during the next 2 to 3 year period, assessments be completed to determine which additional investments are necessary to ensure reliable, longer term operation of the of the steam system with or without the Zuni equipment. Customer steam demand trends during this period will be re-evaluated, establishing the required production capacity to meet the long term demands. Based on this updated assessment of the equipment and the steam demand, we will recommend a path forward for support of the steam supply business.

The options available are presented in a separate report.

Introduction and Background

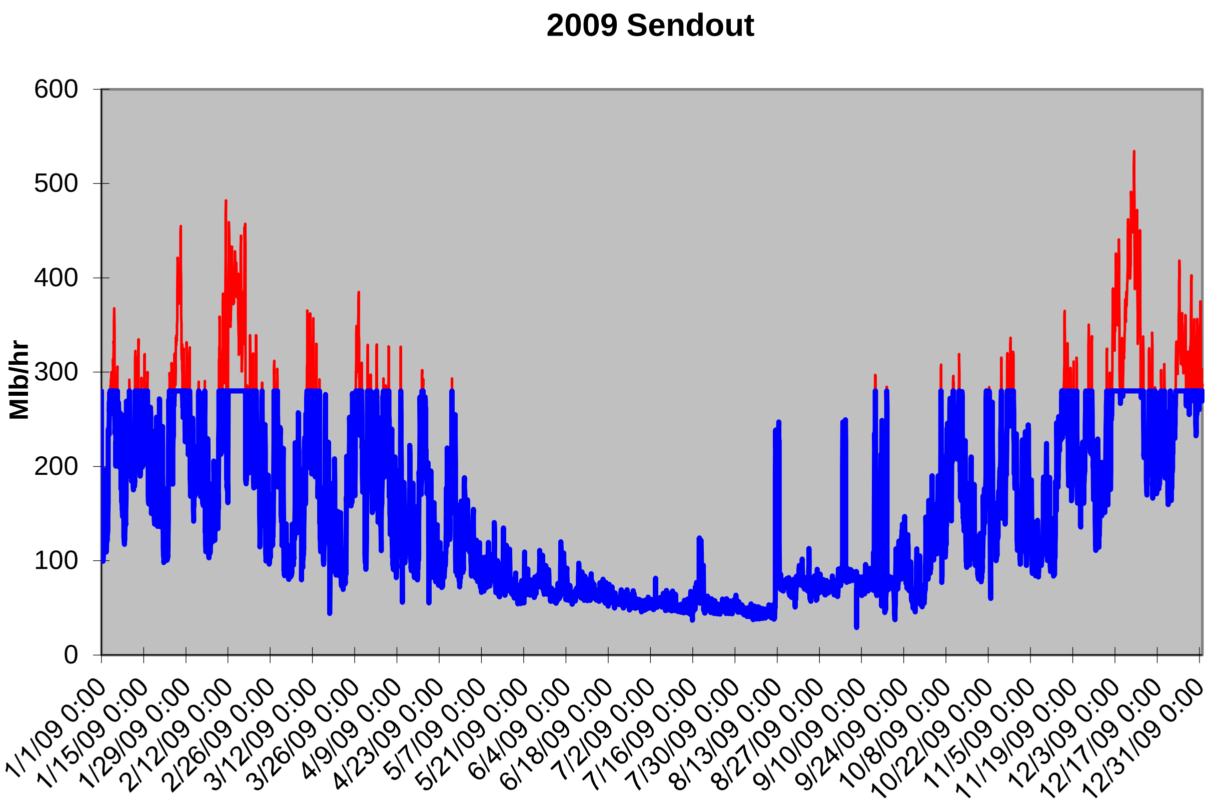
Zuni Unit 2 consists of a 66,000 KW turbine-generator and a single outdoor Babcock and Wilcox boiler capable of delivering 675,000 lbs. of 905^{o}F steam per hour at 925 psig. The unit was placed into service in September of 1954. It was initially a coal fired unit, that was converted to a natural gas unit with #6 fuel oil as backup. It is planned that the electric side of this unit will be retired in 2015 and the boiler and auxiliary equipment could continue to operate to support the Denver Steam Heat Distribution System.

Zuni Unit 1A originally consisted of a 30,000 KW turbine-generator and a single outdoor Babcock and Wilcox boiler capable of delivering 360,000 lbs. of 900^{o}F steam per hour at 850 psig. The unit was placed into service in about 1950. It was initially a coal fired unit, that was converted to a natural gas unit with #6 fuel oil as backup. The electric generation equipment was retired in 2010 and the boiler and auxiliary equipment continue to operate to support the Denver Steam Heat Distribution System.

The objective of the Units 1A and 2 boiler assessment is to review what equipment will need to continue to operate for the near term and the condition of that equipment. The study will then review the risks for long-term operation and determine what upgrades or replacements are needed to insure the plant will continue to be reliable for peaking and backup generation for the extended future. The initial plan was to only retain one of the two boilers at Zuni, boiler 1A or 2, for future operation to minimize cost. Since there would not be any backup to the remaining boiler it is imperative that we insure that the equipment is reliable.

The Zuni Power Plant is currently configured for electrical generation and steam production for users in the downtown Denver area. Due to the addition of the combined cycle at the Cherokee expansion, electricity generation from the Zuni facility is not required. The electricity side of the facility is planned to be phased out in 2015. The consumers of steam however will not be phased out; and due to the PUC decision not to allow a modern replacement, the existing Zuni facility is still required to produce steam for these users for the near term.

The Denver steam distribution system demand varies significantly throughout the year. The following load profile provides the steam demand from 2009 which will be used as typical for the steam plant analysis. The peak demand is about 500,000 lb/hr. The spike sendout, 534,000 lb/hr, as noted in December of 2009, is treated as uncertain since the data recording may have been inaccurate due to faulty instruments.



Current supply to the steam distribution system is provided by:

Plant	Steam Export (lb/hr, max)
DSP	260,000
Zuni	280,000
State	80,000
Total	620,000

A forced outage of Zuni during peak steam demand would leave the system capacity significantly below (about 72%) peak demand.

Currently Zuni is capable of supplying 280,000 lb/hr of sendout. The limit is due to the capacity of the tie-line (steam transmission line to downtown Denver). Today as in the past boiler 1A has been the primary supply of steam; Unit 2 has only been operated in a steam-only mode when Unit 1A was unavailable which has not occurred in the last 15 years. This is due mainly due to the size of the unit, Unit 2 being a much larger unit than is needed, and Unit 1A being rated at 360,000 lb/hr of 900^{o}F steam per hour at 850 psig is much closer to the required sendout requirements. This year boiler 1A has continued to be the primary boiler used to provide steam to the steam heat distribution system, and currently boiler 2 is not available to replace valves after the recent boiler feed pump failure.

Zuni Generating Station

Location: Near downtown Denver, Colo., on the east bank of the South Platte River.

Plant Description: Zuni is a natural gas or #6 oil-fired electric generating peaking station. The facility also supplies steam for delivery to Xcel Energy's thermal energy customers in downtown Denver.

Power Production Capabilities And Steam Output: Rated 66 megawatts (MW) from Unit 2, but currently limited to 30 MW with a boiler feed pump unavailable. Zuni Station is also capable of supplying 280,000 pounds of district heating steam per hour.

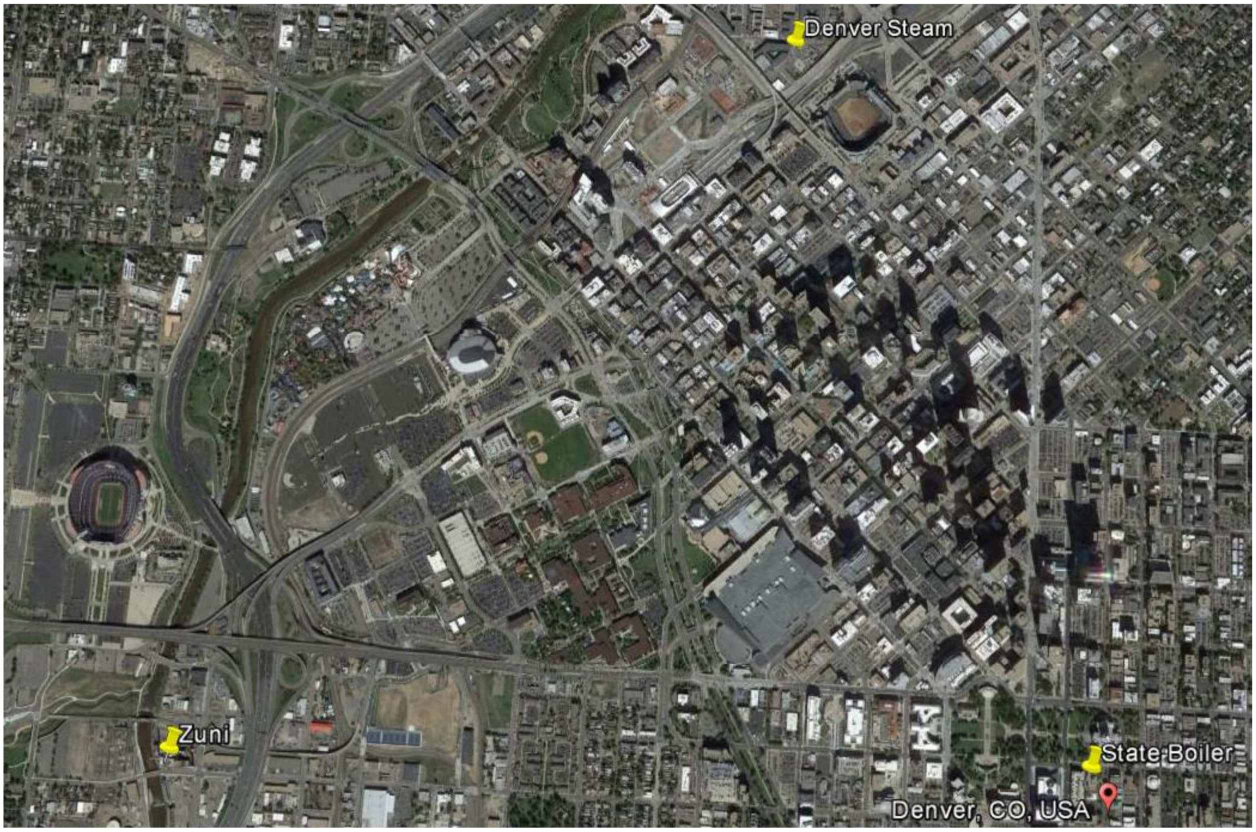
Fuel Source: The plant normally uses natural gas for fuel. Number six fuel oil also can be used during curtailment of natural gas supply.

Boiler History

Zuni Unit 1A is a three drum B&W Stirling design boiler, originally designed in 1947 to fire coal or natural gas. The coal firing capability has been decommissioned and #6 oil added as a backup fuel. A companion boiler (Unit 1B) and the Unit 1 steam turbine is retired. The present sole function of this boiler is to provide steam to Denver buildings.

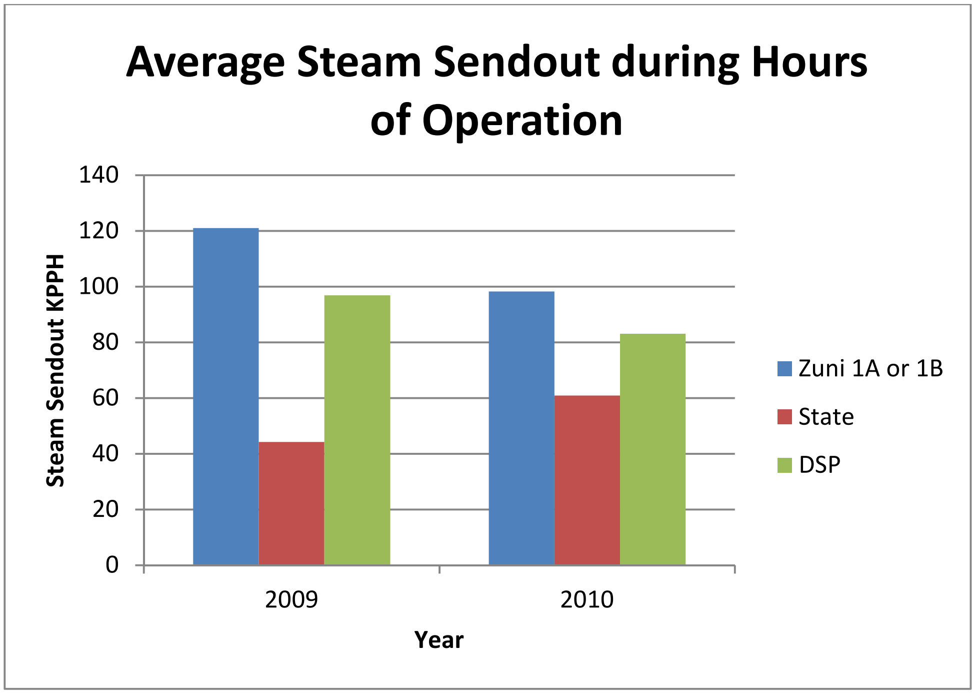
Zuni Unit 2 is a two drum B&W Stirling design boiler, originally designed in 1951 to fire coal or natural gas. The coal firing capability has been decommissioned and #6 oil added as a backup fuel. This boiler can supply steam for electrical generation. The turbine generator unit will be retired by the end of 2015 and this boiler is available thereafter for steam production only.

Steam Distribution



Steam is distributed from the three facilities into a network of underground steam piping to up to 135 users. The distribution system consists of an intermediate pressure (IP) and an low pressure (LP) steam distribution system with various locations for regulating valves and take-offs to each user. The steam system pressure control is provided by regulation stations.

The Denver Steam Plant (DSP) provides the primary means of controlling IP steam pressure. The Zuni plant is called on to supplement the DSP when steam consumption is increased or if the DSP boilers are not available. The LP steam is supplied by reducing stations from the IP steam line and also from the State Boiler.



The average steam sendout when the unit is operating (shown above) is dependent on user consumption for district heating and also by steam plant availability. DSP has an annual one month outage in the summer. During that outage the Zuni plant is the only supply to the IP steam system.

Future Operation

For future operation as follows:

The following are the conditions Zuni Units 1A and 2 are expected to produce:

Steam Flow per boiler: 60,000 to 300,000 lb/hr (limited to 280,000 lb/hr total sendout)

Steam Pressure after Pressure Reducing Valve: 300 psig

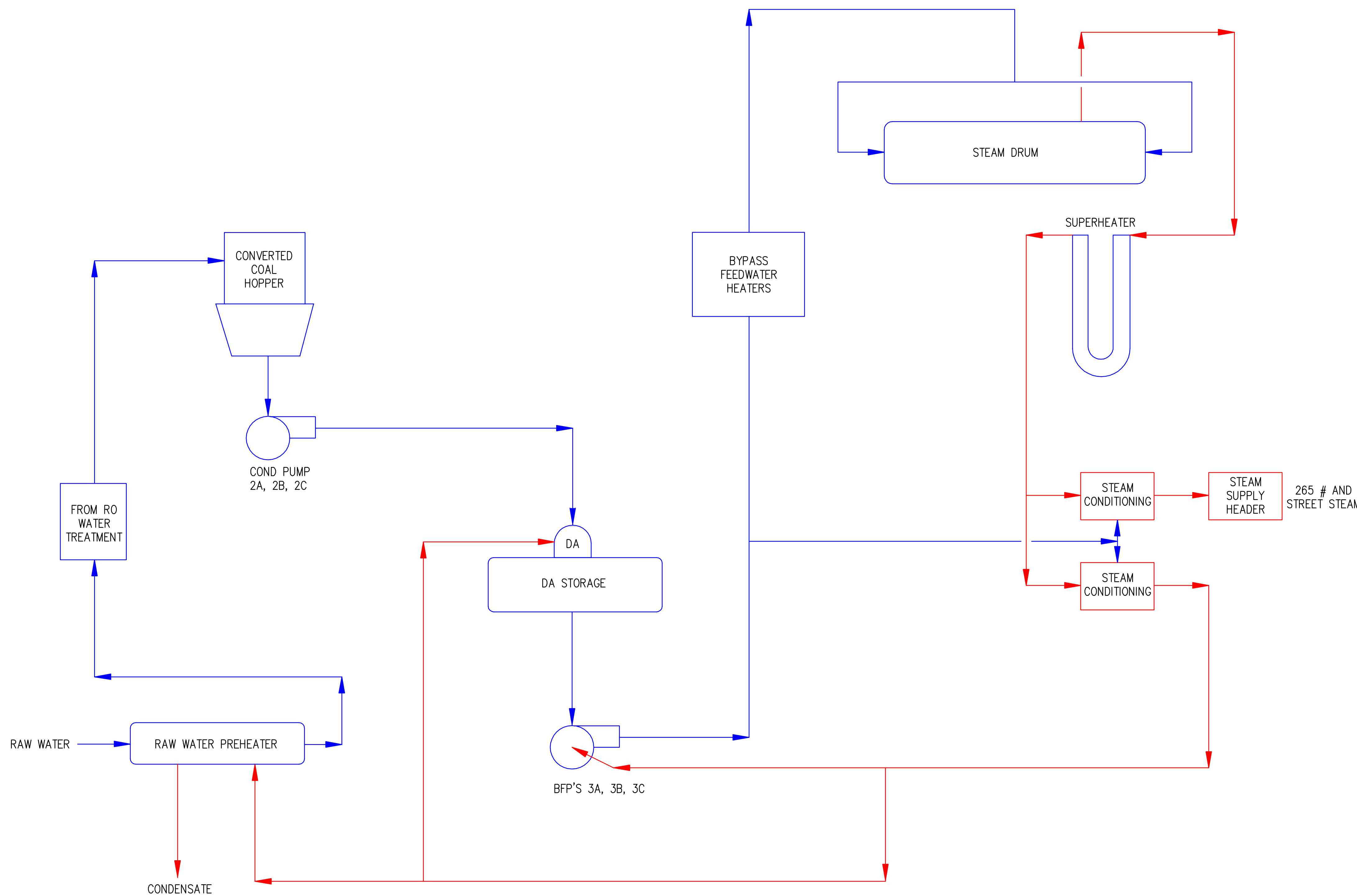
Steam Temperature after terminal Attemperator: 10°F above saturation = 432°F

Historically, the operators have been able to maintain stable control of the Unit 2 boiler when production is around 100,000 lb/hr during start-up and soak. The replacement of the feed water regulation valve is expected to improve operational capability down to 60,000 lb/hr.

The operators have also indicated that there is an issue with the expansion joints when operating the boiler at steam temperatures above 400°F. Expansion joint modifications are required to achieve these conditions.

The following flow diagrams show pertinent equipment involved in steam only service:

ZUNI STEAM PLANT PROCESS CONVERSION UNIT 1A BOILER PROCESS FLOW DIAGRAM



REV	DATE	DESCRIPTION	DRAWN	CHECKED	ENGINEER	PROJECT ENGINEER	PROJECT MANAGER
A	5-1-10	Process Flow Diagram	LR				

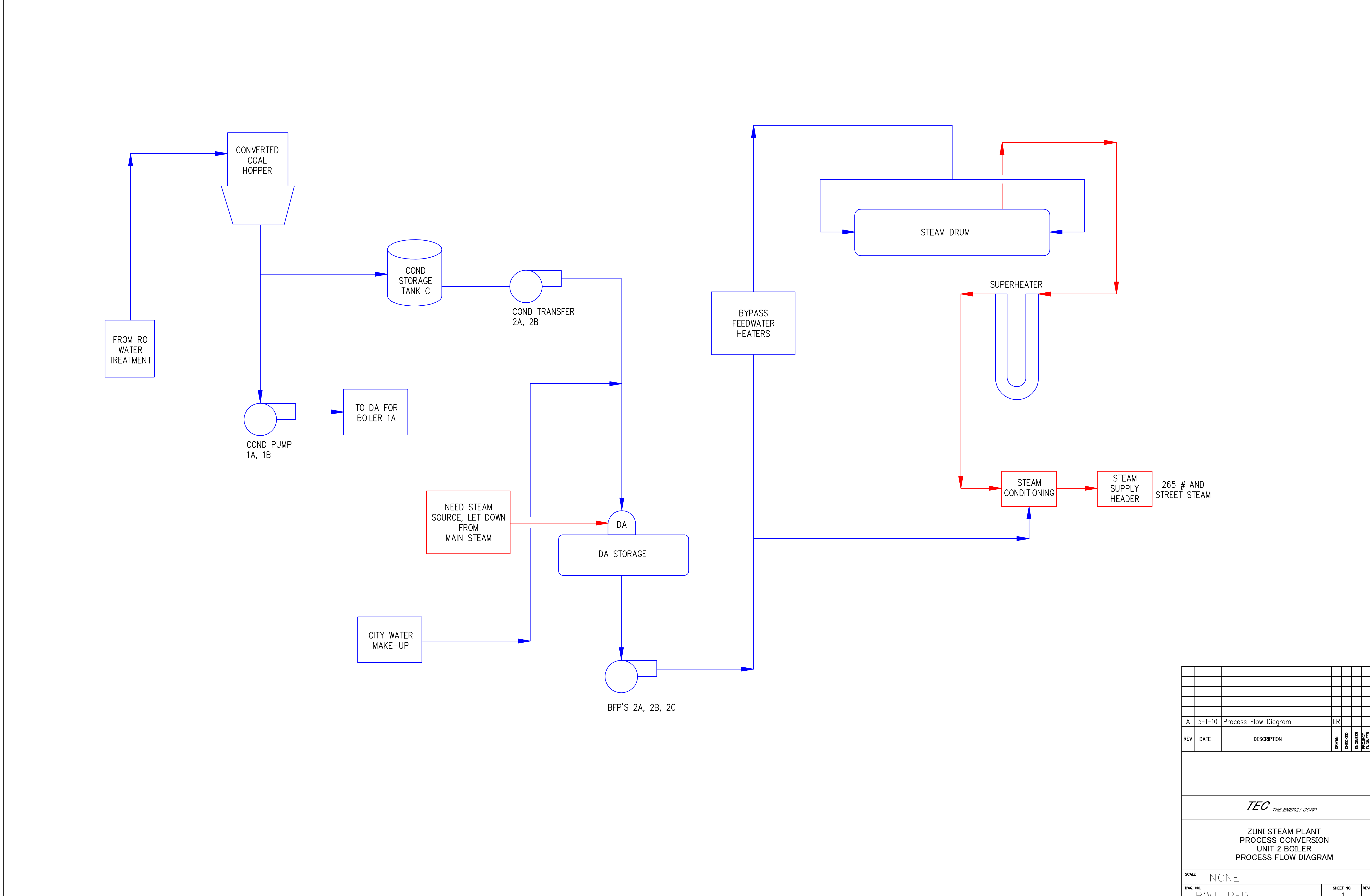
TEC THE ENERGY CORP

ZUNI STEAM PLANT
PROCESS CONVERSION
UNIT 1A BOILER
PROCESS FLOW DIAGRAM

SCALE: NONE

DWG. NO.: RWT-PFD | SHEET NO.: 1 | REVISION: A

ZUNI STEAM PLANT PROCESS CONVERSION UNIT 2 BOILER PROCESS FLOW DIAGRAM


CONVERTED COAL HOPPER
FROM RO WATER TREATMENT
COND STORAGE TANK C
COND TRANSFER 2A, 2B
COND PUMP 1A, 1B
TO DA FOR BOILER 1A
NEED STEAM SOURCE, LET DOWN FROM MAIN STEAM
DA
DA STORAGE
CITY WATER MAKE–UP
BFP'S 2A, 2B, 2C
BYPASS FEEDWATER HEATERS
STEAM DRUM
SUPERHEATER
STEAM CONDITIONING
STEAM SUPPLY HEADER
265 # AND STREET STEAM
A 5-1-10 Process Flow Diagram LR
REV DATE DESCRIPTION
TEC THE ENERGY CORP
ZUNI STEAM PLANT
PROCESS CONVERSION
UNIT 2 BOILER
PROCESS FLOW DIAGRAM
SCALE NONE
DWG. NO. RWT–PFD
SHEET NO. 1
REVISION A

Options Under Consideration

The study objective is to briefly evaluate the following options for producing steam from the Zuni Facility. For a more complete comparison of the options available throughout the system, refer to the Steam Supply Options report.

Option 1 – Operate Boiler 2 Only

Boiler 2 would be isolated from the steam turbine and only provide steam to the steam distribution header. Boiler 1 would be decommissioned.

Modifications to the supporting equipment and controls would be required. The boiler could be modified to more reliably meet the steam only steam conditions, but this is not being considered with this near-term option.

The plant would be re-evaluated after 5 years to determine reliability of the equipment and evaluated for continued operation in this mode.

Option 2 – Operate Boiler 1A Only

Boiler 1A would continue to be used as a steam source for the District Steam System. Boiler 2 would be decommissioned.

Modifications to the supporting equipment and controls would be required. The boiler could be modified to more reliably meet the steam only steam conditions, but this is not being considered with this near-term option.

The plant would be re-evaluated after 5 years to determine reliability of the equipment and evaluated for continued operation in this mode.

Option 3 – Operate Boiler 1A and Boiler 2

Boiler 1A and unit 2 would continue to be used separately as a steam source for the District Steam System. Due to the critical need to having a steam source at Zuni to be capable to supply steam during peak periods and during backup period and due to the age of the Zuni equipment, two units are more likely to provide the reliability needed. Modifications to the units being considered would be control system improvements on both Units 1A and 2, and modifications/upgrades to some supporting equipment.

The plant would be re-evaluated after 5 years to determine reliability of the equipment and evaluated for continued operation in this mode.

Option 4 – Boiler 1A remains as is, Modifications to Boiler 2

Boiler 1A would be operated as it is currently in the steam only mode, with minimum investment in supporting system and controls modifications. Boiler 2 would be modified as per B&W recommendations for safe, reliable long-term operation.

The modifications to the Unit 2 boiler would be such that each boiler will produce 60 to 300 kpph steam depending on demand. This configuration will allow an unplanned outage of any one of the steam sources and still meet the peak demand.

The plant would be re-evaluated after 5 years to determine reliability of the equipment and evaluated for continued operation in this mode

Option 5 – Boiler 1A remains as is, De-commission Boiler 2, Install Package Boiler

Other recommendations are to consider installing one or more package boilers at the Zuni site or at the DSP site. It can be considered that the permitting would not be cumbersome since this would be a trade-off for decommissioning the existing boilers. The package boiler would be tied into the existing steam header for distribution and would be designed to produce steam at the required flow and conditions for the distribution header.

The modifications to the Zuni boiler 1A would be such that the boiler produces 60 to 300 kpph steam depending on demand. This configuration will allow an unplanned outage of any one of the steam sources and still meet the peak demand.

Tabulation of Options

Option	Cost Ranking	Steam Reliability Ranking	Activities Required
1	Low	Low	Inspections; modifications would involve the replacement of the BFP regulation control valve and a significant upgrade of the control system, increase condensate transfer pump capacity, and piping modifications for steam only operation.
2	Low	Low	Inspections, modifications include stack recoating, boiler refractory and feed water heater repairs, and a significant upgrade to the control systems.
3	Low	Medium	Inspections; modifications would include those above for Options 1 and 2.
4	Medium	Medium	Same as Option 1, but also incorporate B&W Recommendations for Boiler 2 Modifications (modifications for Unit 1A as in Option 2 above)
5	High	High	Inspections, boiler 1A only (with modifications identified in Option 2), and install new package boiler(s)

Plant Equipment Assessments

The main components for operating the Zuni facility as a steam only plant consist of:

- Boilers
- ID and FD Fans
- Pumps – Boiler feedwater pumps, condensate supply pumps
- Deaerators and DA storage tanks
- High Energy piping and supports
- Control valves – pressure, level, temperature and flow control valves
- Safety valves
- Instrument and Service Air
- Stacks
- Building
- Service Water Cooling Tower (used for component cooling)
- Water Treatment
- Water Storage
- Oil storage and heating (backup fuel)

Also under consideration is the future status of Evaporation Pond 14 if the city takes over the land. If this occurs, the plant will have to be permitted to discharge to the city sewer. The cost to upgrade the sewer line to accommodate operating the plant without the evap ponds is estimated to be $250,000. The maintenance pool building occupies the land expected to be turned over to the city and would have to be relocated.

The following provides an assessment of the existing equipment. Recommendations to repair, replace or upgrade the existing equipment are included in this section and are based on operating the units in steam-only mode.

Unit 2 Assessment

Boiler

Unit 2 boiler inspection was completed by Diamond Technical Services on January 24, 2014. The results from the inspection identified fourteen (14) possible leaks at the furnace roof and one (1) in the primary superheater (PSH). The unit was pressure tested at 180 psig. Robert Howard performed the inspection of the boiler and confirmed the leaks. ALSTOM completed the repairs in the PSH and then completed the repairing of the pinhole leaks in the furnace roof tubes. The other leaks at the roof are tube to header seals. All repairs have been completed and the boiler is ready for service.

Boiler 2 was erected in 1951. A thorough operating history of the boiler is not available, therefore, it is difficult to determine remaining boiler service life, but the boiler appears to be in adequate condition and could provide another 5-10 years of service.

During the most recent inspection several tube leaks were found and repaired. Tube samples were taken and there was indication of elevated Deposit Weight Density (DWD) of up to 27 gm/ft^2 on the furnace tubes. The accumulated material deposits can cause overheating and/or corrosion on the boiler tube inside surface. Placing this boiler in service as a cycling unit, responding to steam demand, can exacerbate the deposition problems. Cyclic operation can cause iron transport issues, and load changes will result in additional deposit locations as the steam/water conditions change in the tubes. Monitoring and trending of the tubes is recommended using tube skin thermocouples and a recorder. This level of DWD is on the low end of a decision to proceed with chemical cleaning. If the tube monitoring reveals and increase in tube wall temperature, then chemical cleaning may be warranted.

Superheater tubes may also be subject overheating due to the new low load operation of the boiler. Low flow conditions may result in “starved” tubes that will reach the temperature of flue gas resulting in failure of the tube. See the B&W report (Attachment 2) for additional details on superheater tube flow restriction.

The options for this boiler during steam-only operation are:

1. Do Nothing. Isolate the boiler from the steam turbine and supply only to the steam distribution header.

   Advantages – No changes to the existing boiler. Boiler has sufficient capacity. There are two FD fans and two ID fans on this boiler.

   Disadvantages – Boiler start-up time is 1.5 hours. Two (2) Operators are required to operate in steam only mode since the unit can only be operated in manual. Boiler controls will need to be upgraded to safely and reliably operate the unit. Current feedwater regulating valve is not able to control drum level at low loads. Condensate transfer pumps cannot keep up with the steam flows in steam only mode. This boiler may only be able to operate at a minimum of 80,000 lb/hr steam production. Possible additional tube failures as listed previously.

2. Modify Boiler for Turndown operation (for details see B&W report in Attachment 2)

   Modifications and Analysis

   - Modify burners for turndown operation for stable combustion
   - Modifications to the Air heaters for corrosion protection
   - Plugging or removal of some superheater tubes for better low-load distribution
   - Circulation study between the primary furnace and convection pass
   - Replacing the Deaerator
   - Determine a source and add piping for DA steam, raw water preheating and building heat

- Install superheater steam thermocouples for controllability
- Add pump capacity to the condensate transfer system for feedwater to the DA

Advantages – Stable operation of the boiler. An analysis and evaluation would provide modifications to ensure reliable boiler operation in the steam-only mode.

Disadvantages – Cost and life. The boiler has been in operation since 1951, without a complete operating record. Even after modifications are performed, the life expectancy of the boiler components and the future cost to repair / replace components cannot be determined.

Boiler Controls

To enhance the operability of Unit 2 boiler and provide more reliable operation, it is recommended that the boiler controls be upgraded to a modern control system. This upgrade would be similar to the partial upgrades performed on Boiler 1A. The pneumatic controllers in the control room would be replaced with a PLC with operator interface and feedback from the controlling elements. The new PLC would incorporate the boiler combustion controls, feedwater supply and steam sendout. This upgrade includes the PLCs, actuators, instruments, wiring and installation. The cost of these upgrades is included in the cost analysis.

The existing BMS does not comply with the latest NFPA 85 requirements. The cost to upgrade to comply with current NFPA 85 is included. If the current boiler BMS is considered by Xcel to provide "an acceptable degree of protection from the hazards addressed" in NFPA 85, then an upgrade to meet current NFPA 85 standards is not required.

FD and ID Fans

The fans were inspected in late 2013. Based on inspection, fans are in good condition. Operation of up to 300,000 lb/hr of steam with natural gas would require use of only one of the two fans, with the other available as backup.

The controls for the fans and louvers are in need of rebuild and replacement of some components. When modulation is required the linkages and drives tend to get stuck or not operate requiring additional operator involvement.

Pumps

All three Boiler feedwater (BFW) pumps were rebuilt within the last 3 years. BFW pump motors for 2C and 2A were recently rewound. The rebuild on pump 2A was not performed satisfactorily resulting in a flow and head shortfall compared to the B and C pumps. It has been reported that when both Pump A and C are required, pump C has to carry more of the flow and the motor amperage is potentially encroaching on the service factor. It is recommended that motor amps are monitored and determined if it is operated above a 1.0 service factor. A quote from another company to rebuild the A pump was solicited. If warranted the pump could be removed, rebuilt and re-installed at an estimated cost of $55,700.

The B pump has been removed from service due to a catastrophic failure in April 2014. The failure occurred during a boiler start-up with the steam turbine at about 4 MW. The pump had to be shut down during the start-up because the drum level was approaching the high level trip.

The procedure of shutting down the pumps to control drum level has been adopted by the plant because the existing drum level control valve cannot control drum level properly due to valve leakage and controllability. When the B pump was shut down due to high level, an attempt was made to close the pump discharge isolation MOV. A manual close was attempted because the MOV failed to fully close the valve. Also, the pump discharge check valve did not close and the drum water flowed backwards through the pump. The pump went into reverse over speed and seized due to loss of bearing lubrication, causing damage to the pump and catastrophic damage to the pump motor. Currently there is no plan to rebuild the B pump and replace the motor.

Based on experience, the condensate transfer pumps cannot keep up with steam flow when boiler 2 is only producing steam for send out versus some steam going to the steam turbine. Additional pump(s) to increase the water supply capacity to the DA storage tank are required for steam-only operation. The added pump(s) will be able to keep up with the 100% make-up required during steam only operation. Sizing requirements for the additional pump(s) has not been determined.

Boiler Feedwater Pump Discharge Valves

Due to the catastrophic failure of the pump B and the results of a root cause analysis, it has been determined that the BFW pump discharge valves should be replaced. The valves to be replaced are check valve BFD-301, corresponding to pump A discharge, and check valve BFD-303, corresponding to pump C discharge. The existing valves are plug-type check and should be replaced with tilting disc checks. The corresponding two (2) isolation valves should also be replaced. The replacement valves would be gate valves with Limitorque operators. The estimated cost to replace the existing valves and install four (4) new valves is $92,020.

Deaerator and Deaerator Storage

The deaerator for boiler 2 is near the end of its life and needs to eventually be replaced based on pitting damage. The wall thickness is reaching minimum wall, however we believe it will make it for five more years. If it is determined to continue to operate Unit 2 beyond that time the DA will likely need to be replaced.

The current source of steam to the DA is from 20^{th} stage steam turbine extraction line. When the steam turbine is decommissioned, and the boiler is used for steam-only operation, a steam source is required to supply the DA. It could not be determined from the P&IDs that there is an existing steam source into the line that feeds steam to the DA. It is assumed that a source currently exists since this unit has operated in steam-only service previously. If this is not correct, a line and steam conditioning station is required from the main steam that can be let down to feed the DA.

For more dependable operation, the DA dump valve requires updating. An automatic DA level control valve is recommended since currently the storage tank level is controlled via a manual dump valve.

Pipe and Supports

The main steam line was inspected in January 2014. It was found that one static hanger rod on the main steam was completely broken, and there were 3 more with rods bent out of the acceptability range. These have now been repaired or replaced.

Steam connections from the auxiliary steam letdown also need to be piped to supply the DA, raw water preheating to the RO system and building heat supply, following the decommissioning of the steam turbine to allow steam-only operation.

Condensate fibercast piping is insufficiently supported and some sections of the pipe should be replaced. The current spacing of the fibercast piping is approximately 2 times the recommended span. Additional supports are required along the length of the piping. Also, some sections of the pipe should be replaced because of considerable patching on the piping. Properly supporting the pipe and replacing some sections should alleviate future failures of the condensate line.

Control Valves

It has been determined that the Boiler 2 feedwater regulating valve should be replaced. The performance/sizing criteria for the replacement control valve was developed from plant operating data and expected future performance on steam-only operation. The performance was submitted to Advanced Control Equipment for valve sizing and price. The estimated cost of a replacement control valve including installation is $97,200.

A full evaluation of the steam conditioning pressure and temperature control valves is required. It has been noted that the logic for the steam conditioning valves is allowing the steam to be attemperated to below saturated steam temperatures (i.e. overspray). This can lead to quenching of the downstream piping and potentially result in through wall cracking of the pipe. The control logic should include safeguards against attemperating the steam to below saturation.

Safety Valves

All safety valves have been inspected and meet Xcel R stamp requirements.

Stacks

Unit 2 stack was inspected in 2002 and found to be in disrepair. It was determined at that time to remove the top 60 feet of the stack. This was completed in the summer of 2003 along with other minor repairs. At the end of the repairs the stack was deemed suitable for safe and reliable operation.

The stack was more recently inspected in June 2014 by International Chimney Corporation, and the findings from the report are as follows:

Exterior: The concrete column was found to be solid and in sound condition throughout the full height of the stack with no spalling or major cracking. The exterior coating was found to be intact and tightly bonded. Lightning protection, tension bands and the breeching ductwork were also inspected and found to be in good condition.

Annular Space: The exterior of the brickwork and lining tension bands are solid and in sound condition throughout the full height. The concrete column was also found to be solid and sound.

Interior: The brick lining interior was inspected and found to be solid and sound throughout the height with no cracking or spalling. The mortar joints were solid and full throughout the full height. The lining floor was heavily damaged during the previous top portion demolition. The condition did not appear to affect the structural integrity. The ductwork breeching and access doors were found to be intact and in good condition.

The stack is deemed suitable for continued service.

If a continuous emissions monitoring system (CEMs) is required for the stack, the estimated installed cost is $120,000.

<u>Water Supply</u>

The amount of water storage using the former coal bunkers and the condensate tank is adequate to supply the boiler for about 8 hours at steam production of 300,000 lb/hr. The RO water treatment system cannot supply makeup fast enough, and for operation beyond about 8 hours, city water is used to supplement condensate quantity. Additional RO capacity would be needed for extended operation at the maximum capacity for city steam supply. Operators also reported that the pre-filter for the RO needs to be replaced.

The following table provides Unit 2 boiler mechanical equipment assessment for steam-only operation.

Unit 2 Boiler Mechanical Equipment Assessment

Equipment Description	Condition	5 year Failure Probability	10 year Failure Probability	Risks	Action	Notes
Condensate Storage Bunkers	Good	Low	Low	Unknown	None	
Condensate Pump 2A	Good	N/A	N/A	N/A for Steam Only	Out of service for steam only	This pump will be retired after U2 electric is retired end of 2015
Condensate Pump 2B	Good	N/A	N/A	N/A for Steam Only	Out of service for steam only	This pump will be retired after U2 electric is retired end of 2015
Condensate Pump 2C	Good	N/A	N/A	N/A for Steam Only	Out of service for steam only	This pump will be retired after U2 electric is retired end of 2015
Feedwater Heater bypass, 26th stage		N/A	N/A	N/A for Steam Only	None	Bypassed
Feedwater Heater bypass, 23rd stage		N/A	N/A	N/A for Steam Only	None	Bypassed
Deaerator # 3	Poor	High	High	Excessive pitting	Perform annual inspections and re-evaluate	Significant Pitting exists
Deaerator Storage Tank	Poor	High	High	Through wall failure	Perform annual inspections and re-evaluate	Significant Pitting exists
Condensate Storage Tank 5 (C)	Good	Low	Low	Unknown	None	
Condensate Transfer Pump 2A	Fair	Medium	Medium	Loss of steam supply, casing integrity	Add pump(s) for increased capacity	Pumps are not large enough to supply for 100% make-up
Condensate Transfer Pump 2B	Fair	Medium	Medium	Loss of steam supply, casing integrity	Add pump(s) for increased capacity	Pumps are not large enough to supply for 100% make-up
Boiler Feedwater Pump 3A	Good	Low	Low	Unknown	Rebuild to reach base line performance	Rebuilt recently
Boiler Feedwater Pump 3B	Poor	N/A	N/A	Future status unknown	Out of service	Pump seized, motor experienced catastrophic failure
Boiler Feedwater Pump 3C	Good	Low	Low	Unknown	None	Rebuilt recently
Feedwater Heater bypass, 9th and 15th stage	Good	Low	Low	Unknown	None	
Boiler (Breakdown by others)	Good	Medium	Medium	Unknown	Continue annual inspections and repair as required	
Steam Conditioning 265# Steam	Good	Low	Low	Unknown	None	
Steam Conditioning Street Steam	Good	Low	Low	Unknown	Correct control logic	
Water Treatment Plant for 100% make-up	Good	Medium	Medium	Loss of Steam Supply	Increase Capacity	Evaluate depending on selected steam supply option
Boiler Chemical Feed - Phosphate	Good	Low	Low	Unknown	None	
Boiler Chemical Feed - Sulphite	Good	Low	Low	Unknown	None	
Instrument Air Compressor	Poor	High	High	Unknown	Install Compressors	Compressors are at Zuni site

Equipment Description	Condition	5 year Failure	10 year Failure	Risks	Action	Notes
Service Air Compressor	Good	Low	Low	Unknown		
Drum Feedwater Regulator Valve	Poor	High	High	Lack of drum level control	Replace with Fisher control valve.	Drum Level is difficult to control with existing reg valve. Drum level control is attempted by shutting down pumps.

Unit 1A Assessment

Boiler

Boiler 1A is currently operating in steam-only mode. There is a high level of operator confidence in operating this boiler for steam only. Some of the controls have been upgraded to make the unit more operator-friendly.

The boiler was inspected by United Dynamics Corporation Advanced Technologies in May 2014. Findings from the inspection revealed failure of refractory in several locations. The refractory in these locations failed due to thermal fatigue and vibration. The disposition was to replace failed refractory and relocate refractory that became dislodged. This is expected to be an ongoing issue and will require annual maintenance expenditure.

In June 2014, the 1A boiler was hydrotested at the conclusion of the assessment inspections and repairs, and was found to have several tube leaks. These were repaired in a few days and the boiler returned to service. However, the scheduled annual outage of DSP was delayed as a result.

The options for this boiler are:

1. Do nothing. Continue operating the unit as it currently configured.

   Advantages – Operators are familiar with this operation.

   Disadvantages – Based on B&W's report the boiler is operated below its design conditions. Tube side circulation and distribution issues are probable. These issues may already exist in the boiler and damage may accumulate during further low load operation resulting in tube failures. There is only one FD fan with no back-up.

2. Modify Boiler for Turndown operation (for details see B&W report Attachment 2)

   Modifications and Analysis

   - Modify burners for turndown operation for stable combustion
   - Modifications to the Air heaters by blocking surface
   - Plugging or removing superheater tubes for better distribution
   - Modification to drum steam separators for reduced flows
   - Circulation study between the primary furnace and convection pass
   - Repair Feedwater heater (The 1A FW heaters have blown gaskets, 1B FW heaters have been used when there are problems with 1A FW heater, or the FW heaters are bypassed during operation, adding thermal stress to the boiler pressure parts.)

   Advantages – Stable operation of the boiler. An analysis and evaluation would provide recommendations for modifications ensuring reliable boiler operation in the steam only mode.

Disadvantages – Cost and life. The boiler has been in operation since 1947. Accumulative damage is practically impossible to determine since a full operating history is not available. Even after modifications are performed, the life expectancy of the boiler components is unknown.

Boiler Controls

The existing BMS does not comply with the latest NFPA 85 requirements. The cost to upgrade to comply with current NFPA 85 was developed. If the current boiler BMS is considered by Xcel to provide "an acceptable degree of protection from the hazards addressed" in NFPA 85, then an upgrade to meet current NFPA 85 standards is not required.

FD and ID Fans

The fans were inspected in late 2013. The fans are in good and reliable condition. The draft system controls are recommended to be replaced. The pneumatic controls would be replaced by new actuators with logic and I/O to the existing ABB C700 system.

Pumps

BFW pumps are 3 steam-driven and 1 electric-driven (smaller). The exhaust from turbine drive (3 psi) is used for RO preheat and building heat. The electric pump is used when the steam demand is in the 40,000 to 50,000 lb/hr range. Annual O&M costs are applied to maintain these aging pumps and drives in good working condition.

Condensate booster pumps appear to be in good condition, and the capacity is adequate for steam-only operation of Unit 1A.

Deaerator and Deaerator Storage

The 1A and 1B deaerator vessels were inspected in May 2014. Two magnetic particle tests were performed revealing no evidence of corrosion fatigue or other cracking. A complete visual inspection was then performed. There were no indications or cracking observed during the visual inspection. It was concluded the vessels were fit for service. It is recommended to grit blast the vessel welds and perform a wet florescent magnetic particle inspection in both vessels after 3 more years of operation.

Pipe and Supports

It is expected that several main steam pipe supports are in need of repair. Further inspection should be performed, and repairs made as necessary.

Condensate fibercast piping is insufficiently supported and some sections of the pipe should be replaced. The current spacing of the fibercast piping supports is approximately 2 times the recommended span, more consistent with the practice for steel pipe. Additional supports are required along the length of the piping. Also, some sections of the pipe should be replaced because of considerable patching on the piping. Properly supporting the pipe and replacing some sections should alleviate future leaks and failures of the condensate line.

Control Valves

An evaluation of boiler feedwater regulator valve should be considered for better drum level controllability at reduced loads. As a minimum, the actuator should be replaced on the BFW regulator valve, but it is recommended to replace the entire control valve.

A full evaluation of the steam conditioning pressure and temperature control valves is required. It has been noted that the logic for the steam conditioning valves is allowing the steam to be attemperated to below saturated steam temperatures (i.e. overspray). This can lead to quenching of the downstream piping and potentially result in through wall cracking of the pipe. The control logic should include safeguards against attemperating the steam to below saturation.

Safety Valves

All safety valves will be inspected and are currently certified to meet Xcel R stamp requirements.

Stacks

In 2002 the Unit 1 stack was inspected and its overall condition was considered fair. Since it was designed to handle both Units 1A and 1B, It should also be investigated if the stack height can be reduced for steam-only operation.

The stack was more recently inspected in June 2014 by International Chimney Corporation and the findings are as follows:

Exterior: The inspection revealed that loose and spalling concrete has been removed and was never replaced leaving some rebar exposed throughout the height of the stack. The structural integrity of the stack has not been compromised. It was decided that the actions to extend the life of the stack would be to externally coat the stack to stop the further progress of concrete spalling. The cost to externally coat the stack is $210,220 which includes all equipment, material, labor, supervision and mobilization.

Interior: Access to the interior was limited due to the strong draft and blowing debris within the base of the lining. There was no evidence of brick or concrete debris at the lining base and it was deemed the interior brickwork and concrete were solid and sound.

If it is determined that the dispatch of this unit dictates a continuous emissions monitoring system (CEMs) is required for the stack, a cost has been quoted. The cost is $120,000 installed.

Water Supply

The amount of water storage using the former coal bunkers (1,085,000 gallons total storage) and the condensate tank can supply the boiler for about 8 hours at steam production of 300,000 lb/hr. The RO water treatment system cannot supply makeup fast enough, and for operation beyond about 8 hours, city water is used to supplement condensate quality. Additional RO capacity would be needed for extended operation at the maximum capacity for city steam supply. Operators also reported that the pre-filter for the RO needs to be replaced and that cost is included in the evaluation.

The following table provides Unit 1A boiler mechanical equipment assessment for steam-only operation.

Unit 1A Boiler Mechanical Equipment Assessment

Equipment Description	Condition	5 year Failure	10 year Failure	Risks	Action	Notes
Condensate Storage Bunkers	Good	Low	Low	Unknown	None	
Condensate Booster Pumps, 1A	Good	Low	Low	Unknown	Rebuild as required	Better condition than transfer pumps
Condensate Booster Pumps, 1B	Good	Low	Low	Unknown	Rebuild as required	Better condition than transfer pumps
Deaerator # 1	Good	Low	Low	Pitting and tray damage	Inspect again in 3 years	
Deaerator Storage Tank	Good	Low	Low	Pitting	Inspect again in 3 years	
Boiler Feedwater Pump 1A (Turbine Drive)	Good	Low	Low	Reduced steam production if failure of 2 pumps	Continue Maintenance	Maintain seals and monitoring instruments
Boiler Feedwater Pump 1B (Turbine Drive)	Good	Low	Low	Reduced steam production if failure of 2 pumps	Continue Maintenance	Maintain seals and monitoring instruments
Boiler Feedwater Pump 1C (Turbine Drive)	Good	Low	Low	Reduced steam production if failure of 2 pumps	Continue Maintenance	Maintain seals and monitoring instruments
Boiler Feedwater Pump 1D (electric Drive)	Good	Low	Low	Low capacity	Continue Maintenance	Electric drive pump, smaller capacity than the turbine drive pumps
Boiler (Breakdown by others)	Good	Medium	Medium	Tube leaks	Inspect and repair as needed	
Steam Conditioning 265# Steam	Good	Low	Low	Unknown	None	
Steam Conditioning Street Steam	Good	Low	Low	Not dependable	Replace	
Steam Conditioning Turbine Drive BFP	Good	Low	Low	Unknown	None	
Water Treatment Plant for 100% make-up	Good	Medium	Medium	Loss of Steam Supply	Increase capacity pending selected options	Capacity is insufficient for 100% make-up
Boiler Chemical Feed - Phosphate	Good	Low	Low	Unknown	None	
Boiler Chemical Feed - Sulphite	Good	Low	Low	Unknown	None	
Instrument Air Compressor	Poor	High	High	Alleviated by Arapahoe replacement	Install Compressors	Compressors are at Zuni site
Service Air Compressor	Good	Low	Low		Install Compressors	Compressors are at Zuni site
Drum Feedwater Regulator Valve	Poor	Medium	Medium	Lack of drum level control at low load	Rebuild and replace controller	Requires better control at low load operation

Common Systems Assessment

Instrument and Service Air

Instrument air compressors are in bad shape, and being rotary, need a closed discharge valve to start, so can't do it automatically. Plant recently went down due to loss of plant air.

Replacement air compressors were brought up from Arapahoe station to replace the existing air compressors. New instrument air compressors are air-cooled, but existing service air compressors are water-cooled.

Building

The damaged brick walls of the building have been repaired. Building roof was repaired to fix leaks. Operators have commented that there is continued concern on leaks (roof and piping) on the installed electrical equipment and document storage. Roof repair is an ongoing issue requiring annual costs and evaluation unless complete replacement is considered justified.

Service Water Cooling Tower and Piping

The service water cooling tower, a two cell tower, is currently being utilized for component cooling. Based on past experience, the quality of the water has been problematic in that clogging of heat exchangers is prevalent. The existing service water pumps are in good shape for continued use. The heat loads will be significantly less than for electric operation.

Service water system piping is not in very good conditions. Service water cooling tower is in good condition. No chemical treatment is used in the service water system (e.g. to control biological growth, fouling, corrosion).

If the city condemns the property where the tower sits, the service water cooling tower would need to be moved to the Northwest corner and become part of the remaining plant property.

Water Treatment

Service water is no longer treated due to environmental restrictions, and the piping is in bad shape as a result, and the coolers that it serves have corrosion issues. Service water is also used for all BFP bearing coolers, building coolers, and large fan bearing cooling.

RO reject is treated, and is now mixed with service water in CT basin, with blowdown going to ponds. It is not sure where this treated RO reject can go in the future (e.g. city sewer), after land with ponds is sold. It is highly likely the RO reject can be discharged into the sanitary sewer once the electric generation is decommissioned.

The RO system capacity with heated city water feed is 2x50 kpph, or 2x120 gpm. Operators indicated that three (3) double pass 200 gpm RO units would be needed for steam service. At 100,000 pph steam production, water level in bunkers stays level. At 260,000 lb/hr steam production, condensate supply would be depleted in approximately 6 to 8 hours.

Backup to RO is city water only, and if the run is long enough, a chemist operator needs to manually monitor/ control the water quality when only producing steam.

The plant staff may be able to work with Siemens to reconfigure the existing system from a two-pass to one-pass system. Steam only operation does not have as stringent water quality requirements as does steam turbine operation, and the one-pass RO product quality may be sufficient to allow increased capacity with the same number of membranes.

Backup Fuel Heating

An inspection and evaluation of options was done for improving the ability of the plant to keep the #6 oil warm enough to pump during winter operation when a natural gas curtailment is experienced. It was found that the original in-tank tube type heater was replaced at some point with a simple pipe through the bottom of the tank, and this is a very inefficient approach to keeping the oil warm. Also, the tank is not insulated. Adding 3 inches of insulation with lagging to the tank exterior was found to cost about $133,000 installed, and most of that is labor cost. At present, the operators identified a $75,000 annual cost for steam to heat the oil. For extended operation, insulation would have a reasonable payback, but improvement of the in-tank heat exchange approach may also be warranted.

Electrical Systems

Significant repair and replacement is required on the plant electrical equipment. For plant operation in the steam only mode, the following equipment should be considered for repair or replacement for operation past the next 5 years:

1. TRANSFORMERS, 13.8 KV - 2400V, BANKS E & F - Failure of one of the transformers would leave the plant with only a single source for the 2400 V buses.

2. UNIT 1 480 V LOAD CENTERS - These buses have a high arc-flash hazard. Racking the breakers exposes employees to the possibility of injury from an arc-flash. Failure of one of the old circuit breakers could result in heavy damage to the 480 V bus.

3. UNIT 1 DC SYSTEM - Loss of DC power would result in the inability to operate circuit breakers

To minimize cost of continued operation of the plant in the steam only mode, it was decided that these three systems do not have to be replaced. The plant is currently operating successfully with these systems as is. The two transformers provide redundant feed to the plant equipment; loss of one will not prevent the plant from operating. The high arc hazard in the Unit 1 480 V Load Center has been dealt with by restricting access to the room containing the load center. If access to the room is needed to repair equipment, all power to the room can be shut off by a disconnect located on the exterior wall of the room. Loss of the DC system is considered to be a risk but can be minimized since the breakers can be tripped manually without hazard to the operator.

Due to the high potential for failure of this equipment due to its age if replacement is not considered at this time, then keeping both units available to operate so that if a failure on the electric system occurs, the other unit can operate.

Common Systems

Equipment Description	Condition	5 year Failure	10 year Failure	Risks	Action	Notes
Service Water Cooling Tower	Good	Low	Low	Loss of Component cooling water	Replace with closed loop cooling, Fin-Fan	For steam only mode, there is a small demand for component cooling
Service Water Cooling Water Pumps	Good	Low	Low	Loss of Component cooling water	Replace/ Rebuild as required	
Service Water Cooling Water Piping	Good	Low	Low	Loss of Component cooling water	Replace/ Rebuild as required	
Chemical Treatment Pumps	Good	Low	Low	Loss of Component cooling water	Replace/ Rebuild as required	
Chemical Treatment Storage	Good	Low	Low	Loss of Component cooling water	Replace/ Rebuild as required	
RO Trains	Good	Low	Medium	Insufficient Capacity, steam only mode requires 100% make-up	Add capacity based on selected option	Additional RO trains are recommended for reliable, continued operation
RO Prefilter	Poor	High	High	Ineffective prefilter places more duty on the RO trains	Re-charge or replace carbon pre-filters	This should reduce the duty on the RO trains and reduce RO reject thereby reducing raw water consumption
Backup Fuel Heating	Poor	Medium	Medium	Costly and inefficient use of steam that could be sold	Insulate tank exterior	May be justified with extended operation of either boiler

Electrical Equipment Assessment

Equipment Description	Condition	Age	5 year Failure	10 year Failure	Risks	Action	Notes
TRANSFORMERS, 13.8 KV - 2400V, BANKS E & F	FAIR	original	HIGH	VERY HIGH	Failure of one of the transformers would leave the plant with only a single source for the 2400 V buses.	1. Do nothing; 2. Replace 1 transformer; 3. Replace 2 transformers; 4. Re-design the auxiliary electrical supply	The transformers have water in the oil. Treating the oil or replacing the oil could disturb the insulation system
SWITCHES 2179 & 2182	FAIR	original	MEDIUM	MEDIUM	Failure of a switch would leave the plant with only a single source to the 2400 V buses and some of the 480 V buses until a new switch could be installed	1. Do nothing; 2. Service the switches; 3. Replace the switches; 4. Re-design the auxiliary electrical supply	These switches are seldom operated. If they are opened they may not close correctly.
UNIT 1 480 V LOAD CENTERS	POOR	original	MEDIUM	MEDIUM	SAFETY: These buses have a high arc-flash hazard. Racking the breakers exposes employees to the possibility of injury from an arc-flash. Failure of one of the old circuit breakers could result in heavy damage to the 480 V bus.	1. Do nothing; 2. Replace all needed 480 V circuit breakers; 3. Re-design the auxiliary electrical supply.	**A safe working solution is required.** I have never seen 480 V circuit breakers of this type. They are severely out-of -date. The old design switchgear exposes the employees to the arc-flash hazard when racking the breakers.
UNIT 2 480 V LOAD CENTERS	FAIR	original	LOW	LOW	SAFETY: Racking the breakers exposes employees to the possibility of injury from an arc-flash.	1. Do nothing; 2. Replace all needed 480 V circuit breakers; 3. Re-design the auxiliary electrical supply.	**A safe working solution is required.** These breakers are more modern than the Unit 1 breakers, and the arc-flash hazard is lower, but the design requires the door to be open when racking the breaker.
480 V LOAD CENTER TRANSFORMERS A, C, D, G, & H	GOOD	1987	LOW	LOW	SAFETY: the oil-filled transformers are located in the switchgear rooms. A fault in a transformer could result in a severe fire.	1. Do nothing; 2. Enclose the transformers; 3. Re-design the auxiliary electrical supply.	**A safe working solution is required.** NEC requires that oil-filled transformers installed inside a building be put in vaults.
SWITCHES 2178 & 2181	FAIR	original	MEDIUM	MEDIUM	Failure of a switch would leave the plant with only a single source to the Unit 1 480 V buses until a new switch could be installed	1. Do nothing; 2 Service the switches; 3. Replace the switches; 4. Re-design the auxiliary electrical supply	**These switches are seldom operated. If they are opened they may not close correctly.**

Equipment Description	Condition	Age	5 year Failure	10 year Failure	Risks	Action	Notes
LARGE MOTORS	FAIR	original	MEDIUM	MEDIUM	If a single large motor would shut down the unit, then a backup motor should be available.	1. Do nothing; 2. Purchase backup motors	Most motors can be re-wound in a reasonable time so it is likely that no action is needed.
EMERGENCY DIESEL GENERATOR	FAIR	unknown	LOW	LOW	Failure of the emergency generator would result in loss of power to most plant systems.	1. Do nothing; 2. Evaluate the loads on the emergency generator and move loads to provide appropriate support for steam operations; 3. Run an 8-hour full load test	The existing emergency generator may be adequate, but the loading of the unit under 'black plant' conditions should be reviewed. The usual case for the emergency diesels is that they are designed to provide power to the turbine oil pumps, dc systems, UPS systems, some lighting and some HVAC. Over the years changes additional loads are added, but the adequacy of the unit is not studied.
UNIT 1 DC SYSTEM	POOR	Batteries 1986; charger - original	HIGH	HIGH	Loss of DC power would result in the inability to operate circuit breakers	1. Do nothing; 2. Replace the batteries and charger; 3. Re-design the plant DC systems.	The existing DC supply depends on a motor / generator set. IF there is a tie between the Unit 1 and Unit 2 DC systems, then this is a low priority.
UNIT 1 DC SYSTEM	GOOD	Batteries 2004	LOW	MEDIUM	Loss of DC power would result in the inability to operate circuit breakers	1. Do nothing; 2. Replace the batteries; 3. Re-design the plant DC systems	The existing batteries appear to be in good shape, but they will need to be replaced within 10 years.
CABLE	POOR	original	LOW	LOW	Any changes to the electrical system or connections to plant equipment could require installation of new conduit and cable for that service. Cable could be asbestos covered	1. Do nothing	This is an observation only. As an example, a new motor with the junction box in a different location could require new power cable and conduit due to the condition of the existing cable. It is unlikely that an old cable can be pulled out of a conduit and the conduit be re-used for new cable.
LIGHTING	FAIR	various	LOW	LOW	SAFETY - there are locations in the plant where the lighting is minimal. Lighting levels should be reviewed for safety considerations.	1. Do nothing; 2. Improve lighting in needed locations; 3. Replace more lighting	

ATTACHMENTS

Attachment 1 – Schedule for Zuni Study

Thermal Energy Business - Study of Business options and filing CPCN / Reg order

Equipment Assessment

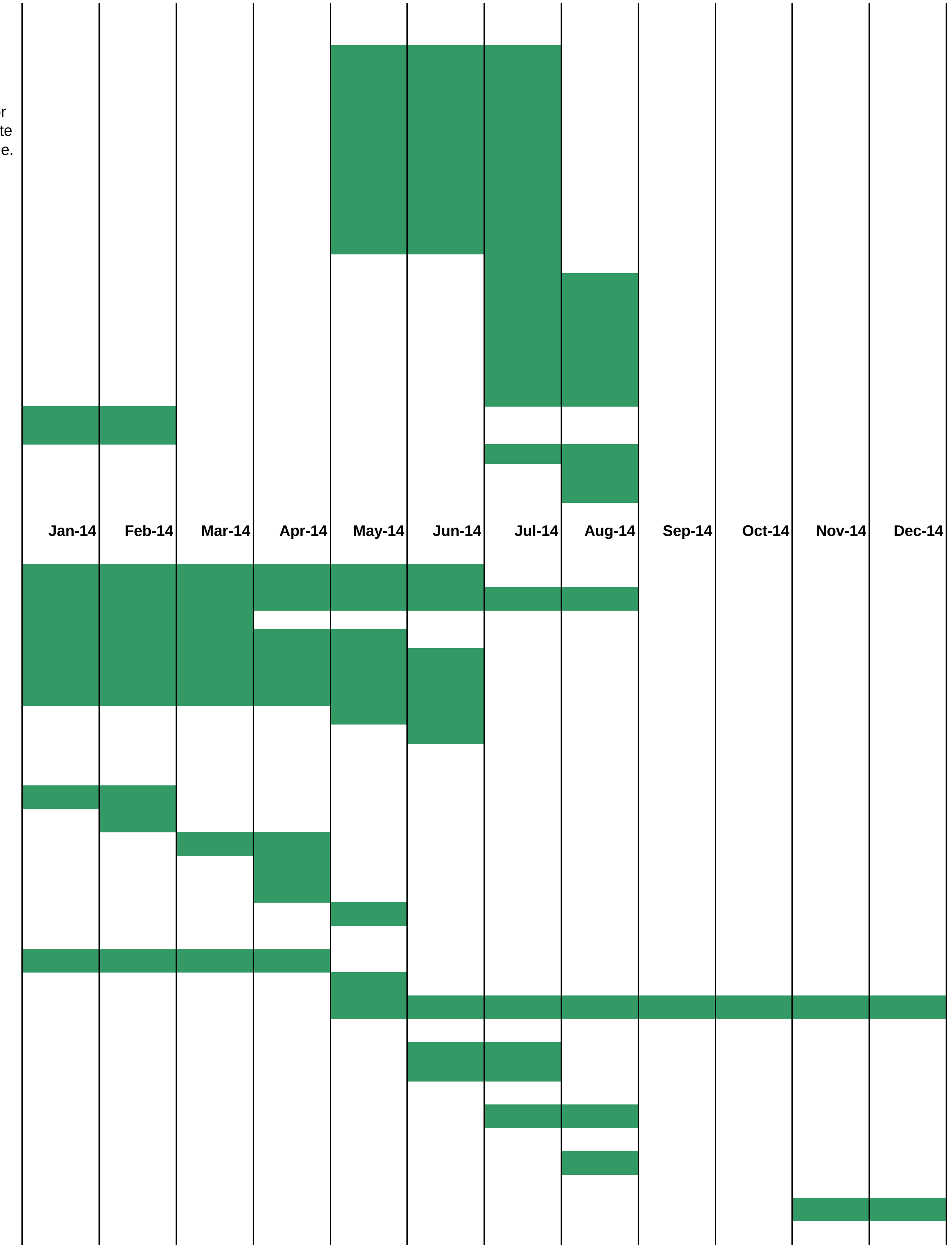
Zuni Unit 2 - Study to determine required modification that need to be made to Unit 2 to allow for the unit to operate safely and reliably for use as capacity for steam distribution system for the indefinite future

	Start	Completion	Status	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
Assessment of equipment needed to operate unit 2 for steam sendout															
Boiler Inspection - Robert Howard			Complete												
Fans (ID and FD)			Complete												
DA, Storage, and Air Receiver Tanks - Kevin McCarthy			Complete												
High Energy Pipe Hangers - Mike Warren			Complete / need to review findings												
Safety Valves			To be performed												
Stacks			Scheduled for this summer												
Building / Roof E&C to take lead			Complete												
Pumps E&C to develop pump list and determine condition			Additional work to be performed												
Electrical Equipment - E&C to develop equipment list and determine condition			Complete												
Controls - E&C to meet with plant and determine needs			Upgrade to be scoped and budgeted												
Valves, Traps, desuperheaters, etc. E&C to develop equipment list and condition			Additional work to be performed												
Air Compressors			To obtain compressor from Arapahoe												
CEMs			Believe replacement required to scope and budget work												
Review of water treatment system E&C to develop equipment list and condition			Additional work to be performed												
Determine what need to be modified to discharge waste to			Additional work to be performed												
Design review by B&W of planned future operation			B&W completed preliminary review they recommend modeling for lower load operation. At this point we plan to do no modeling or design changes. We plan to operate U2 this summer for an extended period to see what operational issues exist if any.												
Review of backup fuel system and need for modifications			No changes planned at this time												
Complete work and develop report to include recommendation, scope, cost, and schedule			Preliminary report issued to management. Findings are that U2 is in fair condition and with minor upgrades is capable of operating for the next five years. Due to the age of much of the equipment there is a high potential for failure but no current signs of imminent failure are known.												
			Status	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14

Assessment of equipment needed to operate unit 1A for steam sendout

Boiler Inspection - Robert Howard	May-14	8/1/2014	To begin work after Spring outages and unit 1A is off line which may work out to be May or Aug. Zuni 1A will need to operate during June for DSP plant outage.
Fans (ID and FD)	May-14	8/1/2014	
DA, Storage, and Air Receiver Tanks - Kevin McCarthy	May-14	8/1/2014	
High Energy Pipe Hangers - Mike Warren	May-14	8/1/2014	
Safety Valves	May-14	8/1/2014	
Stacks	May-14	8/1/2014	
Building / Roof E&C to take lead	Jul-14	8/10/2014	
Pumps E&C to develop pump list and determine condition	Jul-14	8/10/2014	
Electrical Equipment - E&C to develop equipment list and determine condition	Jul-14	8/10/2014	
Controls - E&C to meet with plant and determine needs	Jul-14	8/10/2014	
Valves, Traps, desuperheaters, etc. E&C to develop equipment list and condition	Jul-14	8/10/2014	
CEMs	Jul-14	8/10/2014	
Review of water treatment system E&C to develop equipment list and condition	Jul-14	8/10/2014	
Determine what need to be modified to discharge waste to	Jul-14	8/10/2014	
Design review by B&W of planned future operation	Jan-14	Feb-14	Complete, do not plan to model unit.
Review of backup fuel system and need for modifications	Jul-14	8/10/2014	

Complete work and develop report to include recommendation, scope, cost, and schedule 8/10/2014



Evaluation of Different Generation Options

Zuni Unit 2	12/20/2013	6/27/2014
Zuni Unit 1A	12/210/13	8/29/2014
State Plant (tie to IP system allows 40K additional capacity)	1/1/2014	3/14/2014
Non Company Owned Hotel (tie to IP system allows 80K additional capacity)	Start 3/31/2014	Finish 5/23/2014
Auraria Campus (good location to support system)		6/15/2014
Additional unit DSP or replace U1 with larger unit (able to reduce O&M by having one main plant)		6/15/2014
Possible City of Denver Options (Cherokee Street Steam Plant)		6/15/2014
Review and Modify Engineering Estimates	Start 5/3/2014	Finish 6/20/2014
Recommend Steam Source		6/30/2014

Survey

Customer Survey - develop questions	1/20/2014	2/14/2014
Team Meeting - Survey Questions	2/12/2014	2/12/2014
Customer Survey - perform survey	Start 3/20/2014	Finish 4/11/2014
Customer Survey - analyze results & report	Start 4/14/14	Finish 4/25/2014
Team Meeting - Survey Results		Finish 4/30/2014
Circulate Findings	Start 5/01/14	Finish 5/2/2014

Phase II Rate Case

Phase II rate case analysis	1/2/2014	4/1/2014
File Phase II rate case		5/1/2014
Negotiate rate case & commission's final decision	Start 5/2/14	Finish 12/29/14

Finance

Finance to review estimates and provide final numbers (to receive options + capital and O&M cost for each option)	6/16/2014	7/14/2014

Rates

Rates to determine rate impact of options being considered	7/14/2014	8/1/2014

Management Presentation

Present recommendation to management		8/11/2014

Communication & Cordination Regulatory

Submit / file with the Commission	target 11/26/14	deadline 12//18/14

Attachment 2 – B&W High Level Study

High Level Review of
Zuni Steam Plant
Units 1A and 2

For

Future Reduced Pressure and Temperature Operation

Prepared for

Xcel Energy

Under Purchase Order No. M686142

Prepared by
Babcock & Wilcox
Power Generation Group, Inc.
Sales Order BA9217513
W.A. Hansen
March 11, 2014

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Table of Contents

Executive Summary – Findings of Review

Babcock & Wilcox Power Generation Group has performed a high level review of the operation of Xcel Energy's Zuni Units 1A and 2 for future operation as follows:

Steam Flow: 60,000 to 300,000 lb/hr
Steam Pressure after Pressure Reducing Valve: 300 psig
Steam Temperature after terminal Attemperator: 10 °F above saturation = 432 °F

Several options were investigated for each boiler including:

- Operating at original operating pressure with no modifications to boiler or auxiliaries.
- Operating at original operating pressure with modifications to airheater and burners.
- Operating at reduced pressure with modifications to airheater and burners.
- Operating at reduced pressure and reduced superheater surface with modifications to airheater and burners.

The main difference found between the two boilers is that, due to limitations of steam separation equipment, Unit 1A is unlikely to be able to operate at 300,000 lb/hr at any steam drum pressure below 600 psig while Unit 2 steam drum internals appear to be adequate down to 450 psig.

The second advantage for Unit 2 is that there are parallel forced draft (FD) and induced draft (ID) fans on Unit 2 as opposed to the single FD and single ID fan on Unit 1A. Since future operation is expected to be less than 50% of the current MCR requirements for Unit 2, one pair of FD and ID fans can be used and have a larger controllable range of operation than the Unit 1A fans.

The major common findings for these two boilers are as follows:

1. Units 1A and 2 were designed in 1947 and 1951 respectively. Both boilers have over 60 years of operating history. As such, it is possible that either or both units have components that may be near the end of fatigue life. This may result in unforeseen outages due to tube failures. B&W believes that Xcel should take this into consideration when determining future operation and required reliability.
2. For future conditions, the required turndown for the burners is large. 300,000 to 60,000 lb/hr steam production represents a 5 to 1 turndown on the burners. To be likely to achieve this turndown, the burners must be configured for 300,000 lb/hr as the Maximum Continuous Rating (MCR) of the boiler. This is required to increase the possibility of stable combustion at low loads. At a minimum, this would entail removal of some of the burners and blanking off the openings of the removed burners. For the remaining burners, modifications may include changeout of spud tips, removal of some gas spuds, and reduction of the air flow area of the

burner. The extent of burner modifications required would be identified in the performance analysis recommended in this report.

3. The airheater is oversized for the future conditions. Low boiler exit gas temperature due to the low heat input would result in very low airheater gas outlet temperatures. The probable result of low temperature is corrosion of airheater tubes, reducing the useful life of these tubes. For the future operating conditions, B&W envisions plugging of selected tubes and possible installation of a perforated plate or baffles on the air side of the airheater.
4. The superheater steam side pressure drop at 60,000 lb/hr steam flow is inadequate for superheater overheat protection. Although reducing operating pressure increases the superheater pressure drop, pressure reduction is inadequate as a solution to this issue. In addition, reduced pressure may be detrimental to boiler circulation (see Item 7, below). Since only marginal superheat is required for future operations, the likely correction for low pressure drop is to remove steam flow paths through the superheater, thereby increasing the superheater pressure drop. The number of flow paths or additional heating surface to be removed as well as the effects on heat transfer of other surfaces must be determined by a performance analysis, not included under the scope of this review.
5. One concern regarding the future low load operation is that the water velocity in the steam drum and in tubes may be insufficient for proper mixing of feedwater chemicals with boiler water. This is an issue for which B&W does not have an analytical approach for identification. However, it is noted as a potential problem with the very low future operation.
6. Due to low flow rates in tubing, very low load operation can result in unexpected deposits in tubing. These deposits may become heavy enough to inhibit heat transfer and may result in tube failure.
7. Although this review considered reduced pressure operation for future conditions, this reduction may be detrimental to circulation. While reduced operating pressure may be advantageous in terms of Departure from Nucleate Boiling (DNB), it may be detrimental in terms of stability. Stability is the tendency of a tube to flow upward, downward, or to stagnate. In particular, if a tube were to stagnate, the likelihood of heavy deposition is increased. Only a circulation study at the particular operating conditions intended can identify the circulation issues that would be expected and the corrective actions that are indicated.
8. Based on the experiences of other boilers used for very low load operation, circulation issues may indicate possible future failures in the Unit 1A baffle wall between the primary furnace and the open pass and possible future failures in the Unit 2 baffle wall between the furnace and the convection pass.
9. B&W recommends performance analysis and circulation study of either or both units at the operating pressures selected and at future low and full load steam flows. The performance analysis forms the heat transfer basis of the circulation analysis. It should be noted that Unit 1A is an obsolete design and B&W's methodology for performance analysis is based on later designs of boiler. Unit 2 conforms more closely to a current B&W design. In addition, the intended future operation for either boiler is at steam flows far below the original intended

design. There is an inherent lack of accuracy in the performance analysis when applied to an obsolete design or to very low steam flow (in this case 9 to 15 % of original maximum continuous rating). As such, B&W would not be able to provide any guarantees based on the results of such performance and circulation analysis. However, we believe that we would be able to provide useful recommendations for the reduction of the possibility of tube failures and for the protection of the superheater.

Executive Summary – Recommendations

This high level review of Units 1A and 2 at the intended future operating conditions leads to the following recommendations:

1. For these two boilers, there is no obvious preferred unit for the intended future operation. While Unit 1A would have a lower turndown from original MCR than Unit 2, the design of Unit 2 conforms more closely to a current B&W design. As a result, B&W would have a higher confidence level in the results of a performance and circulation study regarding Unit 2 than such a study regarding Unit 1A.
2. For the purposes of this review, B&W assumed that the fans for either boiler would be controllable down to 20% of their original net requirements. Xcel Energy should review operating history to determine the validity of this assumption.
3. For either boiler, B&W recommends that measures be taken to minimize the amount of time that Xcel continues with the current mode of operation for the following reasons:
   i) At low loads, the superheater pressure drop is inadequate for prevention of overheating of superheater tubing.
   ii) The airheater gas outlet temperature is expected to be low enough to allow condensation resulting in corrosion and possible failure of airheater tubes.
   iii) Until such time as a circulation study is performed, B&W is unable to identify whether reduced pressure operation is advantageous or detrimental to circulation.
4. A combined performance analysis and circulation study should be performed for either boiler based on the following conditions (see Note 9 on Page 5):

   Steam Flow: 60,000 lb/hr and 300,000 lb/hr
   SH Outlet Pressure: Subject to the maximum steam drum operating pressure and superheater pressure drop due to required modifications.
   SH Outlet Temperature: As required for minimum of modifications. This temperature should be in excess of that required to provide 10 °F superheat at 300 psig.
   Superheater pressure drop: Minimum of 5 psig at 60,000 lb/hr steam flow
   Airheater modified as necessary to minimize cold end corrosion.
   Burners modified as necessary to accommodate future load range.

   The study should identify:

   Any expected circulation concerns and remedial action
   Modifications required in the superheater
   Modifications required to the burners
   Modifications required to the airheater

Executive Summary – Order of Magnitude Pricing for Anticipated Modifications

The pricing listed below is based on the assumptions of this review. The actual scope of modifications required would be determined in a performance and circulation analysis. As such, B&W does not recommend implementation of any of these modifications until such time as the analysis is performed.

1. Performance and Circulation Analysis

   The only firm recommendation based on this review is that a performance and circulation analysis be performed on the boiler chosen by Xcel for this type of future operation. This type of analysis would define the extents of modification required to boiler components (such as superheater, burners, and airheater) and may define additional modifications required for future operations.

   Budgetary pricing is listed below. If Xcel wishes to pursue this recommendation, B&W would be pleased to offer a firm priced proposal.

   The budgetary price for this analysis is $77,400.00

2. Superheater Modifications

   The superheater of either boiler would require reduction of steam flow paths to increase superheater pressure drop. In this way, balance of steam flow through different flow paths is enhanced, protecting the superheater from overheat. The scope of the required modifications would be determined in the performance and circulation analysis listed above. For the purposes of order of magnitude pricing, it is assumed that a portion of the superheater tubes would be cut off at either header, the header tube stubs capped, the entire flow path of tubing removed from the boiler, and penetration locations sealed.

   Unit 1A

   Order of magnitude budgetary pricing (D&E) for this work is $400,000.00

   Unit 2

   Order of magnitude budgetary pricing (D&E) for this work is $1,125,000.00

3. Burner Modifications

The burners of either boiler would require modification to make 300 MLB/hr steam flow the new MCR with possible turndown to 60 MLB/hr steam flow.

Unit 1A

For Unit 1A, the initial expectation is to blank off ¼ of the secondary air flow area from each burner and remove and plug two of the eight spuds on each burner (eight burners total).

Order of magnitude budgetary pricing (D&E) for this work is $350,000.00

Unit 2

For Unit 2, the initial expectation is to blank off ½ of the secondary air flow area from each of eight burners and remove and plug four of the eight spuds on each of these burners. The four remaining burners are expected to be completely blanked off (secondary air and gas burner).

Order of magnitude budgetary pricing (D&E) for this work is $500,000.00

4. Tubular Airheater Modifications

The tubular airheater for either of these boilers is oversized. For the order of magnitude estimate, B&W assumed that a portion of the tubes would be capped on both ends.

Unit 1A

Order of magnitude budgetary pricing (D&E) for this work is $350,000.00

Unit 2

Order of magnitude budgetary pricing (D&E) for this work is $875,000.00

Background

In January of 2014, Xcel Energy contracted with Babcock & Wilcox Power Generation Group, Inc. to perform a high level review of Zuni Steam Plant Units 1A and 2. The B&W Contract Numbers at Zuni are S-9432 (Zuni Unit 1A), F-1187 (Zuni Unit 1B), and S-9787 (Zuni Unit 2).

Unit 1A currently supplies steam to various buildings in Denver, Colorado for the purpose of heating water and supplying building heat. Unit 2 currently supplies steam to a turbine for electrical generation. It is B&W's understanding that Zuni Unit 1B is no longer available for operation. As such, this review is of Units 1A and 2.

The purpose of this review is to identify several options for future operation wherein electrical generation is no longer supplied from Zuni and all steam produced is supplied to buildings. Although Unit 1A presently performs this task, Xcel Energy requested that the boilers be reviewed to help identify any longer term issues that might not be readily apparent. Xcel Energy requested that B&W review options for Units 1A and 2 for future modes of operation that are more conducive to long term operation with a minimum of damage to the boilers and accessories.

The future steam demand is expected to be as follows:

Steam Flow: 60,000 to 300,000 lb/hr
Steam Pressure: 300 psig
Steam Temperature: 10 degrees F above saturation, 432 deg F

The method used in this review is to extrapolate data from the original Predicted Performance Summaries and use this data to approximate the requirements of various components for the options considered. It is important to note that rigorous performance analysis is not part of this review. As such, variables quoted for each component are approximations only and are used solely for comparing the likelihood of concerns.

It is intended that Xcel Energy review this report to identify the options that Xcel believes are most promising for future operation. Based on these choices, rigorous performance analysis and circulation analysis should be performed on the options chosen. Only with this type of analysis can changes be implemented with a level of confidence that the changes are beneficial to the long term operation of the subject boiler.

Descriptions of Zuni Unit 1A and Unit 2

Zuni Unit 1A

Zuni Unit 1A (original B&W Contract No. S-9432) is a three drum B&W Stirling design boiler, originally designed in 1947 to fire coal or natural gas. The coal firing capability has been decommissioned and only natural gas is now fired. Figure 1 is a line drawing of Zuni Unit 1A as originally configured.

This boiler has been retired in terms of electrical generation. The present sole function of this boiler is to provide steam to Denver buildings.

The original Predicted Performance Summary lists the following:

Steam Flow mlb/hr	200	300	350	400
Steam Pressure psig	850	850	850	850
Steam Temperature °F	800	855	880	895
Feedwater Temperature °F	320	350	365	375
Fuel	Natural Gas	Natural Gas	Natural Gas	Natural Gas
No. Of Burners in Use	4	4	4	4
Fuel Flow MLB/hr	13.6	20.7	24.3	27.9
Flue Gas ent AH MLB/hr	244	370	434	498
Air Lvg AH MLB/hr	208	316	371	426
Flue Gas Lvg AH °F	305	355	380	405
Unit Efficiency	82.92	81.71	81.19	80.65

For future operation, B&W has been informed that the Unit 1A is tied into the Unit 1B feedwater preheaters and that the preheater outlet temperature is 320°F.

The future requirements for downstream use are as follows:

Steam Flow: 60,000 to 300,000 lb/hr
Steam Pressure: 300 psig
Steam Temperature: 10 degrees F above saturation, 432 °F

This represents 15% to 75% of the original Maximum Continuous Rating (MCR) steam flow.

Information from the Zuni Plant Regarding Unit 1A

Per plant personnel, Unit 1A presently operates from about 40 MLB/hr to 300 MLB/hr with the following operating parameters:

Load Condition	60 MLB/hr	300 MLB/hr
%O2 at Boiler Outlet	4-5%	4%
Steam Drum Pressure psig	375	700
Feedwater Temperature to Boiler °F	320	320
Steam Temperature at SH Outlet °F	643	800

The reduced steam drum pressure at the 60 MLB/hr load is a standard operating procedure. The reason for this is that the load is so low that relatively small variations in firing rate can result in large changes in steam drum pressure, possibly lifting safety valves.

The high feedwater temperature relative to what is expected from a deaerator is due to a tie in between Unit 1A feedwater system and the Unit 1B feedwater preheater. Steam from Unit 1A heats the feedwater for Unit 1A. It should be noted that, in the approximations of performance data that follow, no penalty was assessed against Unit 1A for the steam required for the feedwater preheater. As such, it may appear that less fuel is required in Unit 1A for an operating condition than Unit 2. Much of this difference is due to the feedwater preheater and therefore does not apply to plant efficiency.

Below 60 MLB/hr, the plant standard operating procedure is to open superheater drains to increase flow through the superheater.

Plant Operations targets 4-5% O2 at the boiler outlet for the 60 MLB/hr load case. B&W finds this type of operation to be of concern for several reasons.

1. For in service burners, the secondary air velocity is expected to be low, possibly resulting in incomplete combustion.
2. It is our understanding that out of service burners are completely shut off. However, damper leakage is expected to allow some of the air to pass to idle burners. This reduces the percent excess air available to operating burners and can result in incomplete combustion.
3. If there were no leakage to out of service burners, radiant heat from the furnace could overheat burner components.
4. This O2, after deductions for leakage into the furnace, represents an air flow that is about 11% of the FD fan net capacity. B&W is concerned that this may not be within a good control range for the fan.

Based on these concerns, the following review uses 100% excess air (approximately 20% of FD fan capacity) at the 60 MLB/hr load. We believe that this excess air value is more likely to provide complete combustion and control of the airflow.

B&W was informed that the windbox and controls had been changed in some manner about 15-20 years ago. We do not know what had been changed. Zuni Operations reports that air flow responds slowly to changes in load demand and may not increase as fast as fuel flow.

Although the basis of this review is providing steam at 300 psig and 10°F superheat, plant operations reports that the actual sendout can be down in the 100-200 psig range. In addition, it was reported that the setpoint for the desuperheater is 400°F. Since saturation temperature at 300 psig is 422°F this setpoint is an item of concern. When the sendout is at 300 psig, we would expect that the attemperator valve would be open, possibly sending saturated water downstream with the steam. Plant personnel have reported that water in the steam is an actual occurrence and an item of concern.

It has been reported that there are no flame scanners on Unit 1A. This is an item of concern for personnel protection.

It has been reported that there are no operational thermocouples on superheater outlet legs. Since thermocouples on these legs are usually used for alarms and aid operators in avoiding damage to the superheater, B&W believes that thermocouples should be installed for superheater protection particularly when the intended mode of operation is outside of the original design parameters.

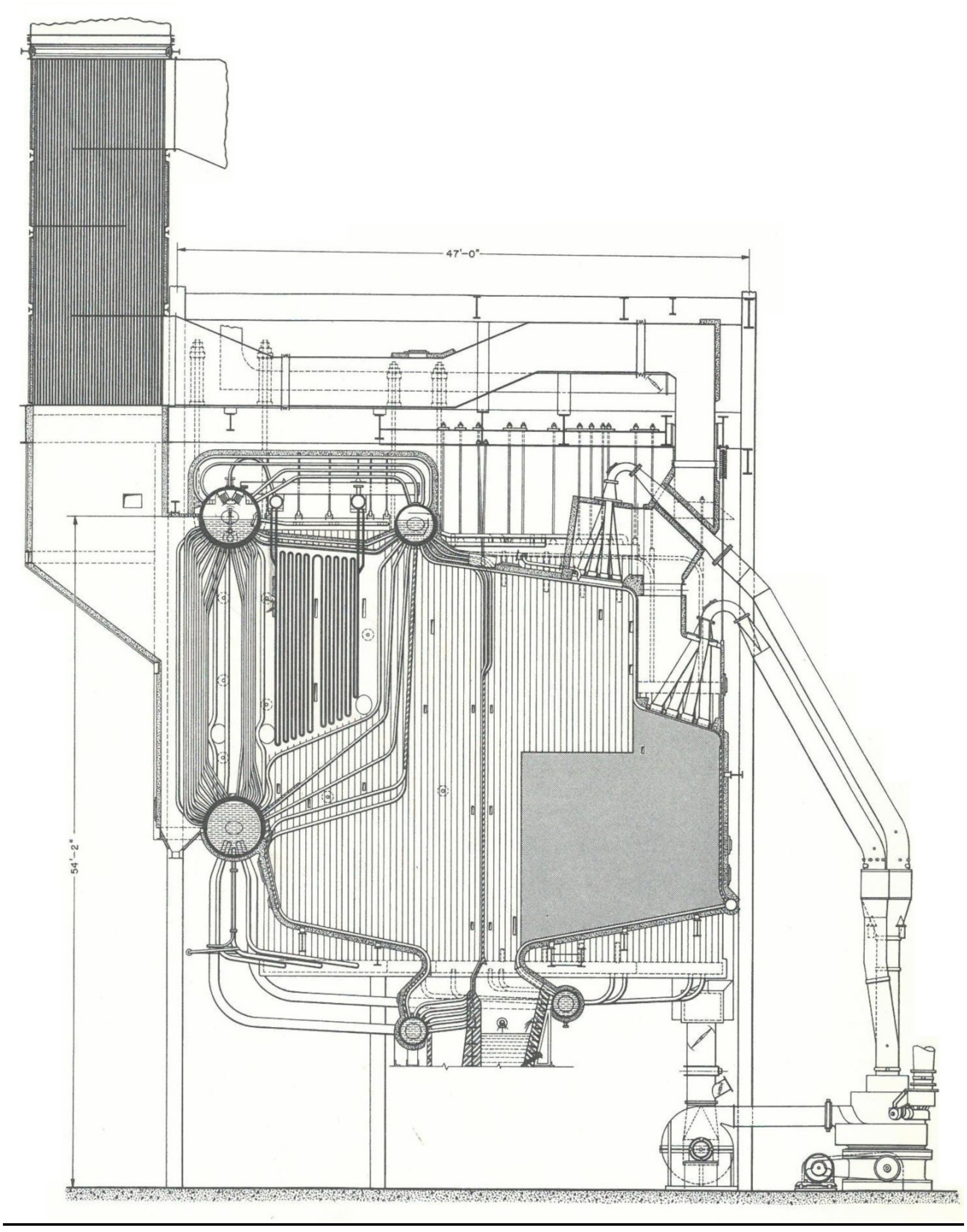


Figure 1

Line Drawing of Zuni Unit 1A

Original B&W Contract No. S-9432

Zuni Unit 2

Zuni Unit 2 (original B&W Contract No. S-9787) is a two drum B&W Stirling design boiler, originally designed in 1951 to fire coal or natural gas. The coal firing capability has been decommissioned and only natural gas is now fired. Figure 2 is a line drawing of Zuni Unit 2 as originally configured.

This boiler continues to supply steam for electrical generation. At sometime in the future, it is expected that this unit will be retired in terms of electrical generation but would be available for steam to Denver buildings.

The original predicted performance summary lists the following:

Steam Flow mlb/hr	425	675
Steam Pressure psig	925	925
Steam Temperature °F	845	890
Feedwater Temperature °F	370	407
Fuel	Natural Gas	Natural Gas
No. Of Burners in Use	8	12
Fuel Flow MCFM	9.22	14.5
Flue Gas ent AH MLB/hr	485	767
Flue Gas recirc MLB/hr	150	150
Air Lvg AH MLB/hr	414	655
Flue Gas Lvg AH °F	291	339
Unit Efficiency	84.0	83.1

The feedwater heaters are to be decommissioned. In the future, the only heating of the feedwater will be through deaeration, producing feedwater and attemperator water assumed to be 220 °F.

The future requirements for downstream use are as follows:

Steam Flow: 60,000 to 300,000 lb/hr
Steam Pressure: 300 psig
Steam Temperature: 10 degrees F above saturation, 432 °F

This represents 8.9% to 44.4% of the original Maximum Continuous Rating (MCR) steam flow.

Information from the Zuni Plant Regarding Unit 2

Per plant personnel, Unit 2 has seldom operated solely supplying steam to the 300 psig header. As such, there is no reliable operating data for this boiler in the intended future mode of operation.

For the future operation of Unit 2, the only feedwater heat available is from the deaerator. Unlike Unit 1A, no feedwater preheater is available.

Although the basis of this review is providing steam at 300 psig and 10°F superheat, plant operations reports that the actual sendout can be down in the 100-200 psig range. In addition, it was reported that the setpoint for the desuperheater is 400°F. Since saturation temperature at 300 psig is 422°F this setpoint is an item of concern. When the sendout is at 300 psig, we would expect that the attemperator valve would be open, possibly sending saturated water downstream with the steam. Plant personnel have reported that water in the steam is an actual occurrence and an item of concern.

It has been reported that there are flame scanners on Unit 2. However, the information provided to B&W indicated that the flame scanners are unable to discriminate between burners and can only identify that there is flame in the boiler. This is an item of concern for personnel protection.

It has been reported that there are no operational thermocouples on superheater outlet legs. Since thermocouples on these legs are usually used for alarms and aid operators in avoiding damage to the superheater, B&W believes that thermocouples should be installed for superheater protection particularly when the intended mode of operation is outside of the original design parameters.

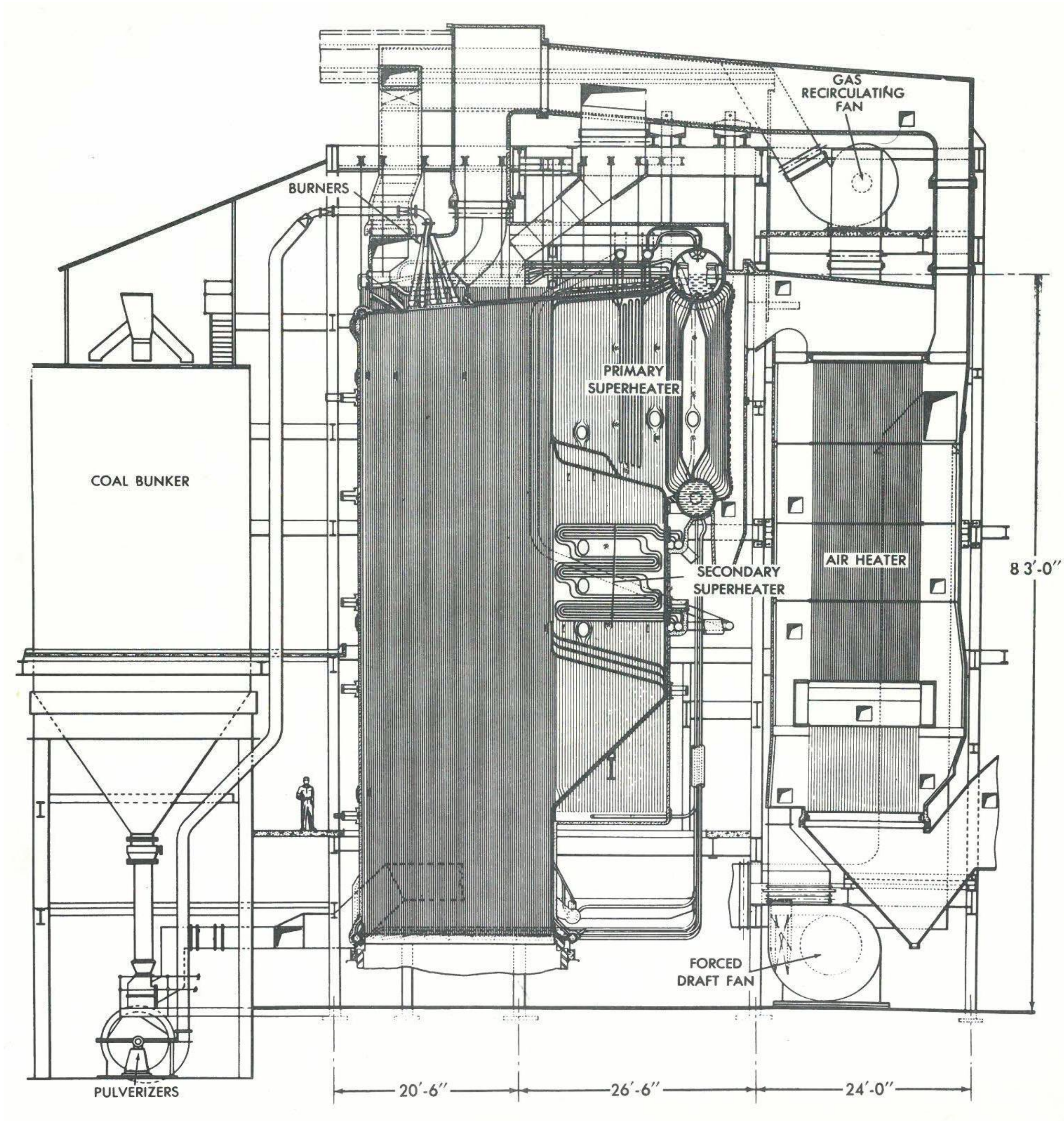


Figure 2
Line Drawing of Zuni Unit 2
Original B&W Contract No. S-9787

Options for Future Operation

The options discussed in this report include the following:

Option 1 – Operate with no modification to boiler or airheater, feedwater preheater in use

Unit 1A has the ability to use the feedwater preheater of Unit 1B. Unit 2 does not have this capability. As such, this option only applies to Unit 1A.

Option 2 – Reduce steam flow, retain superheater as is, modify burners and airheater for new conditions

In this option burners are modified to accommodate the low heat input required for the future demand range. Modifications would include removal of some burners, blanking off the openings for these burners, and changing burner tips and secondary air ports to maintain natural gas pressure and air flow in a controllable range.

The airheater would be modified to maintain a minimum flue gas exit temperature at low load for corrosion protection. For Options 2 through 4, the airheater efficiency is set by assuming an airheater flue gas outlet temperature of 300°F at the low load condition of 60,000 lb/hr steam flow. The modification is assumed to consist of plugging selected tubes of the airheater. An additional benefit of plugging selected tubes is that this creates pressure drop on the flue gas side which helps equalize flue gas distribution through the remaining tubes.

Option 3 – Reduce steam flow, reduce operating pressure, retain superheater as is, modify burners and airheater for new conditions

Option 3 is the same as option 2 but with reduced operating pressure. The positive effect in this option is that the superheater pressure drop is increased by increasing the specific volume of the steam. The increased pressure drop helps to maintain steam distribution through parallel steam paths.

The lower limit to reducing steam pressure is assumed to be where the volume flow at 300,000 lb/hr is no more than the volume flow at the original maximum continuous rating.

For Unit 1A, Options 1 and 2 were reviewed at the current low pressure operation. As such, for Unit 1A, Option 3 is identical to Option 2.

Option 4 – Reduce steam flow, reduce operating pressure, reduce superheater surface, modify burners and airheater for new conditions

In Option 4, the boiler is configured as close as is reasonable to the downstream requirements for steam flow, pressure, and temperature.

Since the Options are applied to Unit 1A and Unit 2, they are identified by unit number and option number (eg. Option 1A-1). In this way, Xcel Energy can compare the findings for both boilers under a given set of assumptions.

Discussion of Findings – Unit 1A

Option 1A-1 –No modification to boiler or airheater, Unit 1A steam to 1B feedwater heaters

This scenario is believed to be the current operating condition with Unit 1A steam going to 1B feedwater heaters. Steam to feedwater heaters was not included in the efficiency calculations.

Steam after Term Attemp MLB/hr	60	300
Boiler Steam Flow MLB/hr	53.7	252.4
Steam Drum Pressure psig	375 *	700 *
Steam Temperature °F	643 *	800 *
Feedwater Temperature °F	320 *	320 *
Superheater Pressure Drop psig	1.9	25.3
Fuel	Natural Gas	Natural Gas
No. Of Burners in Use	1	3
Fuel Flow MLB/hr	3.6	17.4
Flue Gas ent AH MLB/hr	107	310
Air Lvg AH MLB/hr	93	264
Flue Gas Lvg AH °F	239	321
Unit Efficiency	79.1	82.4

- Data from Zuni Plant Operations

Steam flows from the boiler were based off of heat balance around the terminal attemperator for the 60 MLB/hr and 300 MLB/hr loads respectively, assuming that downstream conditions are 300 psig and 10°F superheat.

Excess air was estimated at 100% excess air for the 60 MLB/hr load and 18% excess air at the 300 MLB/hr load. 100% excess air was used for the 60 MLB/hr load since this represents approximately 20% of the net conditions of the one existing FD fan. This was estimated as the low end of the controllable range for that fan. Plant personnel have indicated that for 60 MLB/hr, Zuni Operations targets 4-5% O2 at the back end or 10 to 16% excess air after deductions for leakage. However, there have been instances when changing load that airflow was not very controllable. As such, for this review, B&W has assumed 100% excess air at the 60 MLB/hr load.

Pressure drop through the superheater is poor under these conditions. At the low load condition of 60,000 lb/hr, the superheater pressure drop is estimated at 1.9 psi. Low pressure drop through the superheater can result in poor steam distribution between steam paths of the superheater and can result in overheating of superheat tubes.

At the 60 MLB/hr load, the expected airheater flue gas outlet temperature is low. At 239°F, airheater corrosion is likely. For the following options, the airheater heat transfer is limited to that which produces an airheater gas outlet temperature of 300°F at the 60 MLB/hr load. The airheater performance at 300 MLB/hr is reduced proportional to the 60 MLB/hr load.

Option 1A-2 – Reduce steam flow, retain superheater as is, modify burners and airheater for new conditions

Estimated future performance with removal of one burner and modifying the airheater for corrosion protection is as follows:

Steam after Term Attemp MLB/hr	60	300
Boiler Steam Flow MLB/hr	56.9	249.9
Steam Drum Pressure psig	375 *	700 *
Steam Temperature °F	643 *	800 *
Feedwater Temperature °F	320 *	320 *
Superheater Pressure Drop psig	1.9	25.3
Fuel	Natural Gas	Natural Gas
No. Of Burners in Use	1	3
Fuel Flow MLB/hr	3.7	17.8
Flue Gas ent AH MLB/hr	110	319
Air Lvg AH MLB/hr	96	271
Flue Gas Lvg AH °F	300	410
Unit Efficiency	76.7	80.2

- Data from Zuni Plant Operations

Steam flows were based off of heat balance around the terminal attemperator for the 60 MLB/hr and 300 MLB/hr loads respectively.

As with Option 1A-1, excess air was estimated at 100% excess air for the 60 MLB/hr load and 18% excess air at the 300 MLB/hr load.

As with Option 1A-1, pressure drop through the superheater is poor under these conditions. At the low load condition of 60,000 lb/hr, the superheater pressure drop is estimated at 1.9 psi.

The boiler efficiency for this option is lower than that of Option 1A-1 due to the imposition of an airheater gas outlet temperature of 300°F at the 60 MLB/hr load condition.

The firing rate is higher due to the low feedwater temperature and the reduced efficiency compared to Option 1A-1.

Option 1A-3 – Reduce steam flow, reduce operating pressure, retain superheater as is, modify burners and airheater for new conditions

For Unit 1A, the operating pressure has been previously set. As such, this option is identical to Option 1A-2. This option is listed to retain numbering the same as for Unit 2.

Option 1A-4 – Reduce steam flow, reduce operating pressure, reduce superheater surface, modify burners and airheater for new conditions

This Option differs from Option 3 in that the superheater is modified to set superheater pressure drop. The superheater temperatures quoted are rough estimates.

Expected performance is estimated as follows:

Steam after Term Attemp MLB/hr	60	300
Boiler Steam Flow MLB/hr	58.4	269.7
Steam Drum Pressure psig	375 *	700 *
Steam Temperature °F	488	658
Feedwater Temperature °F	320 *	320 *
Superheater Pressure Drop psig	8.1	112.8
Fuel	Natural Gas	Natural Gas
No. Of Burners in Use	1	3
Fuel Flow MLB/hr	3.7	17.4
Flue Gas ent AH MLB/hr	108	310
Air Lvg AH MLB/hr	94	264
Flue Gas Lvg AH °F	300	369
Unit Efficiency	77.0	81.3

- Data from Zuni Plant Operations

This option appears to be the only one feasible for Unit 1A for the following reasons:

1. The burners and the airheater must be modified for the new heat input conditions. The intended range of operation is a 5 to 1 turndown. This is a high range and, to have a reasonable chance of meeting these requirements, the burners must be optimized for the new high end requirement. The airheater must be modified to minimize cold end corrosion. Expected modifications are:
2. Superheater pressure drop must be increased at the 60,000 lb/hr condition. B&W recommends a minimum of 5 psig pressure drop for protection of superheater tubing.
3. The future full load steam flow is about 5 times the low load steam flow. Since pressure drop varies by weight flow squared (along with other considerations) the full load pressure drop can be approximated at 125 psig for a 5 psig drop at 60 MLB/hr. Operating pressure at the superheater outlet must be reduced to accommodate an increased superheater pressure drop so that the drum operating pressure is below the original at all loads. Due to this consideration plus the expected limitation of steam drum internals due to volume flow at 300 MLB/hr, the superheater outlet pressure at 300 MLB/hr is limited to between 600 and 793 psig. Rigorous

analysis of the boiler performance may define this range further. For this review, the steam drum pressure presently being used at Zuni appears to be in the correct range.

Discussion of Findings – Unit 2

Option 2-1 – No modification to boiler or airheater, feedwater preheater in use

Since Unit 2 has no availability of feedwater preheaters, this option does not apply to Unit 2.

Option 2-2 – Reduce steam flow, retain superheater as is, modify burners and airheater for new conditions

Estimated future performance with removal of six burners and modifying the airheater for corrosion protection is as follows:

Steam after Term Attemp MLB/hr	60	300
Boiler Steam Flow MLB/hr	58.3	258.5
Steam Drum Pressure psig	925.4	932.4
Steam Temperature °F	583	773
Feedwater Temperature °F	220	220
Superheater Pressure Drop psig	0.3	6.9
Fuel	Natural Gas	Natural Gas
No. Of Burners in Use	2	6
Fuel Flow MLB/hr	4.17	20.18
Flue Gas ent AH MLB/hr	111	349
Air Lvg AH MLB/hr	96	296
Flue Gas Lvg AH °F	300	413
Unit Efficiency	77.6	80.1

The feedwater temperature of 220°F was assumed as the outlet temperature of the deaerator.

Steam flows were based off of heat balance around the terminal attemperator for the 60 MLB/hr and 300 MLB/hr loads respectively.

Excess air was estimated at 85% excess air for the 60 MLB/hr load and 18% excess air at the 300 MLB/hr load. 85% excess air was used for the 60 MLB/hr load since this represents approximately 20% of the net conditions of one of the existing FD fans. This was estimated as the low end of the controllable range for that fan.

Pressure drop through the superheater is poor under these conditions. At the low load condition of 60,000 lb/hr, the superheater pressure drop is estimated at 0.3 psi. Low pressure drop through the superheater can result in poor steam distribution between steam paths of the superheater and can result in overheating of superheat tubes.

Option 2-3 – Reduce steam flow, reduce operating pressure, retain superheater as is, modify burners and airheater for new conditions

Under this option, physical changes to the boiler and airheater remain similar to the changes under Option 2-2. Steam pressure is reduced to the point where volumetric flow through the steam drum steam separation equipment is no more than the volumetric flow under original MCR conditions. Based on this criterion, the minimum steam drum pressure is approximately 400 psig.

Steam after Term Attemp MLB/hr	60	300
Boiler Steam Flow MLB/hr	57.7	256.3
Steam Drum Pressure psig	375	450
Steam Temperature °F	508	747
Feedwater Temperature °F	220	220
Superheater Pressure Drop psig	0.7	14.3
Fuel	Natural Gas	Natural Gas
No. Of Burners in Use	2	6
Fuel Flow MLB/hr	4.17	20.20
Flue Gas ent AH MLB/hr	111	350
Air Lvg AH MLB/hr	96	297
Flue Gas Lvg AH °F	300	415
Unit Efficiency	77.5	80.1

The airheater efficiency for this load condition was reduced from that of Option 2-2 to maintain a 300 °F airheater gas outlet temperature at the 60 MLB/hr load. Superheater absorption was assumed the same as Option 2-2 to set the superheater outlet temperature.

The superheater pressure drop for the low load case increased from Option 2 due to the increased specific volume of the steam. However, the superheater pressure drop is well below B&W guidelines of 5 psig for protection of superheater tubing. In this option as well as with Option 2, overheating of superheater tubes is considered a major concern.

Note that unit efficiency and flows stay essentially the same as Option 2-2.

Option 2-4 – Reduce steam flow, reduce operating pressure, reduce superheater surface, modify burners and airheater for new conditions

For future operation, the goal under this option is to modify Zuni Unit 2 to a Maximum Continuous Rating (MCR) of 300,000 lb/hr steam flow at 450 psig and a minimum of 50 deg F superheat (steam temperature of 498°F). The operating pressure of 450 psig was chosen to maintain volumetric flow through steam separation equipment at or below the original MCR. Future operation must include a turndown to continuous supply of 60,000 lb/hr steam flow. This Option differs from Option 2-3 in that the superheater is modified to set superheater pressure drop. The superheater temperatures quoted are rough estimates.

Estimated performance is as follows:

Steam after Term Attemp MLB/hr	60	300
Boiler Steam Flow MLB/hr	59.4	283.7
Steam Drum Pressure psig	375	450
Steam Temperature °F	461	519
Feedwater Temperature °F	220	220
Superheater Pressure Drop psig	6.4	128.5
Fuel	Natural Gas	Natural Gas
No. Of Burners in Use	2	6
Fuel Flow MLB/hr	4.16	20.18
Flue Gas ent AH MLB/hr	110	349
Air Lvg AH MLB/hr	96	296
Flue Gas Lvg AH °F	300	415
Unit Efficiency	77.6	80.2

Note that the low load superheater temperature is less than the 50°F superheat envisioned. However, since these temperatures are estimates extrapolated from the original predicted performance, this is not an item of concern. In a performance analysis, the superheater surface would be set based on minimum pressure drop, minimizing modifications, and setting the outlet temperature.

The following are comments regarding the future operation as defined above:

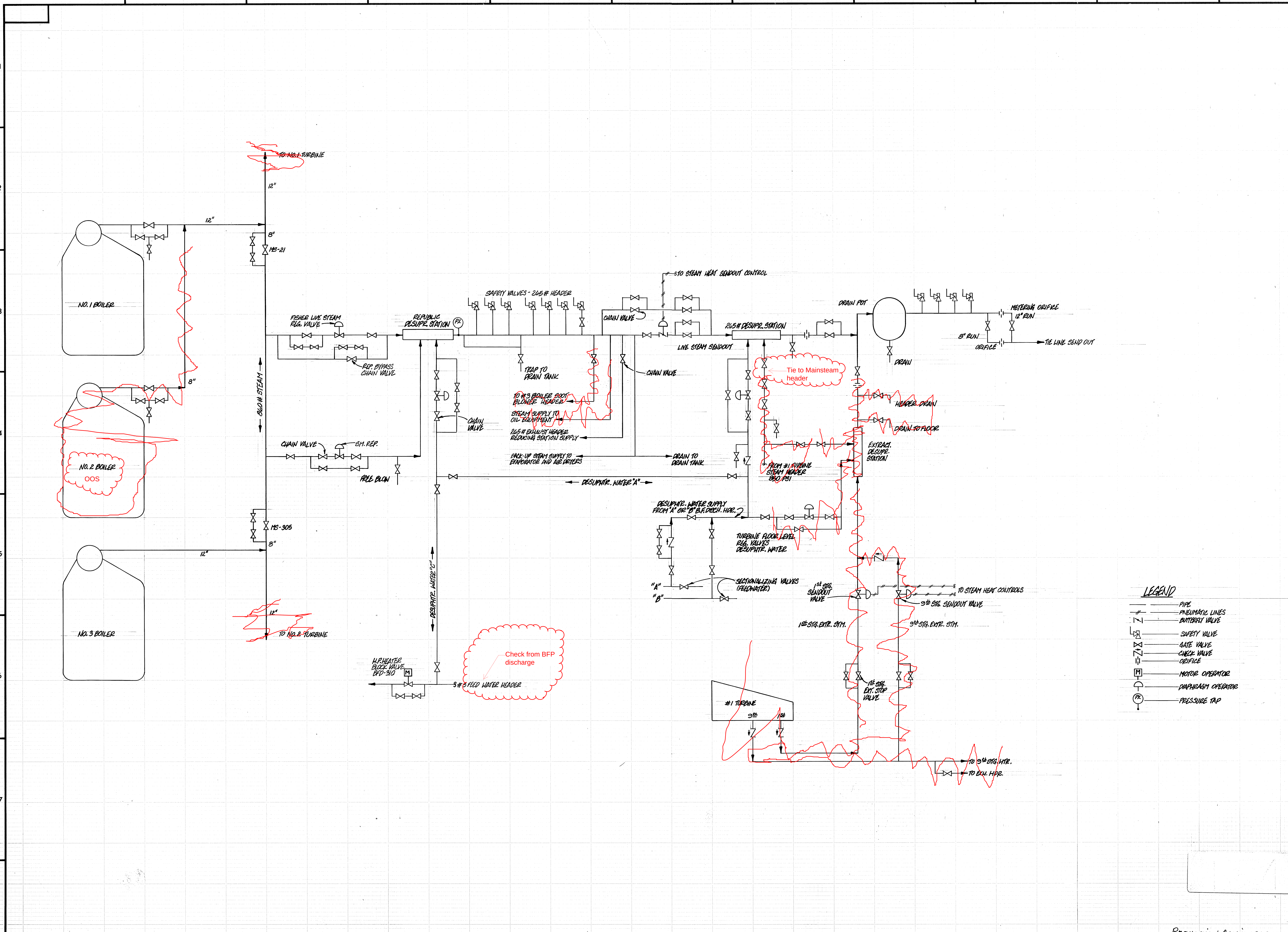
1. At the low operating pressure used, circulation issues are possible. Only a circulation analysis can identify potential circulation issues and remedial actions to address these issues.
2. Decreasing the number of steam flow paths in the superheater increases the superheater pressure drop and reduces the possibility of overheat. If the superheater has a low pressure drop, variations in heat transferred to different flow paths can increase flow imbalance between flow paths. As such, high heat input to a particular flow path can reduce the steam flow and

increase the temperature further, possibly leading to overheat and failure. When the pressure drop is sufficiently high, this type of effect is drastically reduced.

3. Removing burners and closing the related burner openings is necessary for setting a steam flow range of 300,000 to 60,000 lb/hr. This is approximately a 5 to 1 turndown with the top end being 44% of the original MCR. Since the burner throat air velocity must be matched with fuel flow, the choices for complete combustion are operating inefficiently with very high excess air due to out of service burners or modifying the burners to meet the new conditions.
4. Modifying the airheater for the new conditions is required to minimize the possibility of condensation and corrosion.

Attachment 3 – Zuni Plant P&ID Mark-ups for Conversion to Steam Only

a) Drawing 3-10.12 Flow Diagram – Steam Heat Sendout
b) Drawing 3-16.18 Unit 2 Flow Diagram – Condensate
c) Drawing 3-16.19 Unit 2 Flow Diagram – Boiler Feed Suction and Discharge
d) Drawing 3-16.20 Unit 1 Flow Diagram – A & B Condensate
e) Drawing 3-16.21 Unit 1 Flow Diagram – Boiler Feed Suction and Discharge
f) Drawing 3-16.22 Units 1 & 2 Flow Diagram – Main Steam
g) Drawing 3-16.23 Units 1 & 2 Flow Diagram – 265# Steam (sheets 1 and 2)
h) Drawing 3-16.24 Units 1 & 2 Flow Diagram – Extraction Steam



TITLE: REFERENCE DRAWINGS — DWG. NO. / MFGR.

REVISION — NO. ZONE DATE BY CK. — E M A-C (ml)

Approvals: E | M | A-C

Public Service Company of Colorado

ZUNI S.E.G.S.
FLOW DIAGRAM-
STEAM HEAT
SENDOUT

SCALE: NONE

GENERATION DESIGN-MECHANICAL DIVISION

BY RML DATE 1-23-84
CKD. DATE

3-10.12

SHEET 1 OF 1

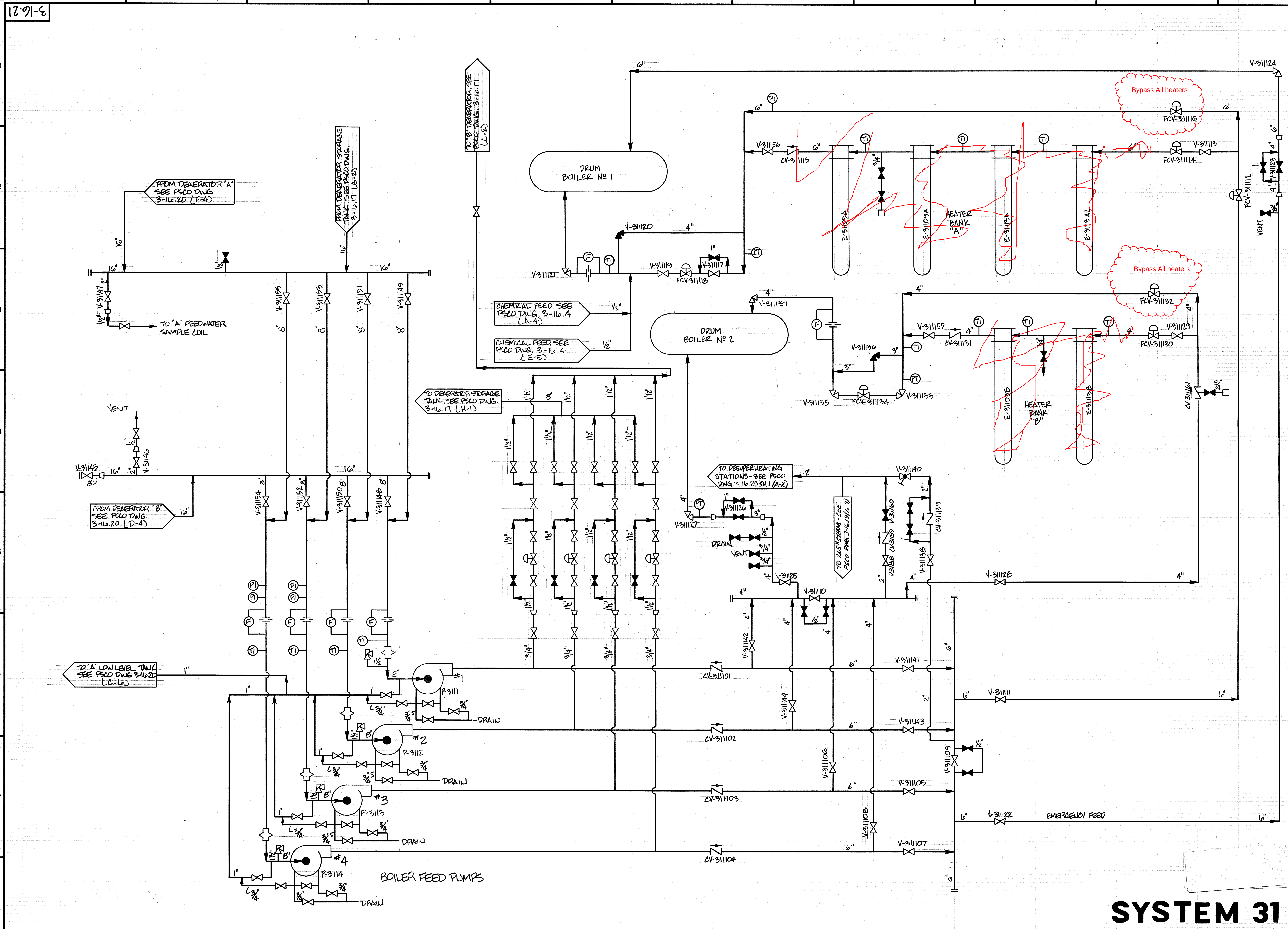
FORM 300-24-3516
0630


DEAERATOR No. 3
DEAERATOR STORAGE TANK
T-31301
VENT COND.
CONDENSATE STORAGE TANK "C"
CONDENSATE TRANSFER PUMPS
P-31204
P-31205
EVAPORATOR FEED PUMPS
P-31206
P-31207
EVAP. PREHEATER
EVAPORATOR No. 2
FLASH POT
DRAIN RECEIVER
TURBINE No 2
20TH STAGE HEATER E-31220
21ST STAGE HEATER E-31226
23rd STAGE HEATER
No 2 CONDENSER E-3102
HOTWELL
INTER CONDENSER
STEAM JET AIR EJECTOR
AFTER CONDENSER
CONDENSATE PUMPS
P-31201
P-31202
P-31203
PERFORATED PIPE
ACID CLEANING CONNECTION
ABANDON
FROM UNIT 1 DEAERATORS SEE PSCO DWG 3-16.20 (C-2)
20TH STG. EXTRACTION STM. SEE PSCO DWG. 3-16.24 (K-5)
FROM LOW LOAD FLASH TANK SEE PSCO DWG. 3-16.25 (F-4)
COLD FILL No 3 BOILER - SEE PSCO DWG. 3-16.19
TO BOOSTER PMP SUCTION SEE PSCO DWG. 3-16.14 (E-2)
FROM 215# STM. SEE PSCO DWG. 3-16.23 (J-6)
FROM EXHAUST STM. SEE PSCO DWG. 3-16.17 (A-2)
FROM HTR DRAINS SEE PSCO DWG. 3-16.25 (G-7)
FROM BFP DISCH. - SEE PSCO DWG. 3-16.19 (K-3)
OFFICE HEAT RETURN SEE PSCO DWG 3-16.17 (A-7)
TO "A" LOW LEVEL COND. STORAGE, SEE 3-16.20 (B-5)
TO #2 GLAND SEAL TANK SEE PSCO DWG 3-16.28 SH.2 (K-3)
TO CHEM. FEED - SEE DWG. 3-16.4 (F-1)
FROM OVERFLOW WTR. STORAGE SEE PSCO DWG. 3-16.14 (E-2)
FROM FUEL OIL STORAGE TANK HTRS. SEE PSCO DWG 3-16.23 SHT 2 (K-5)
FROM COLD ZEOLITE, SEE PSCO DWG. 3-16.14 (B-2)
FROM 45# DOMESTIC WTR. SEE PSCO DWG 3-16.13 (F-3)
FROM VACUUM PRIMING SEE PSCO DWG 3-16.6 (G-5)
TO GLAND SEAL COND. SEE PSCO DWG. 3-16.28 SH.2 (B-6)
FROM L.P. DRIP PUMPS SEE PSCO DWG. 3-16.25 (H-7)
TO UNIT 2 VACUUM PRIMING SEE PSCO DWG 3-16.6 (L-4)
FROM UNIT 1 CONDENSATE SEE PSCO DWG 3-16.20 (J-6)
TO LOW LOAD FLASH TANK SEE PSCO DWG 3-16.25 (K-3)
6TH STG. STM. SEE PSCO DWG 3-16.24 (G-6)
FROM UNIT 2 CONT. BLOWDOWN SEE PSCO DWG 3-16.16 (D-3)
TO #3 SAMPLE TABLE
TO SUMP
VENT TO ATMOS.
SAMPLE PT.
SAMPLE POINT
DRAIN
REVISED PER NEW WTR. TREATMENT SYS.
ISSUED TO FIELD
REVISION
REFERENCE DRAWINGS
Public Service Company of Colorado
ZUNI STEAM PLANT UNIT 2 FLOW DIAGRAM CONDENSATE
GENERATION DESIGN/MECHANICAL
SCALE: NONE
BY RML DATE 12/16/85
CKD. RTA DATE 10/1/87
3-16.18
SYSTEM 31


3-16.19
DEAERATOR No 3 STORAGE TANK
T-31301
V-31222
V-31221
V-31220
V-31201
TO #3 SAMPLE TABLE
SULFITE FEED - SEE PSCO DWG. 3-16.4 (G-5)
RV-312105
RV-312104
RV-312103
V-31204
V-31203
V-31202
3A
3B
3C
P-31208
P-31209
P31210
V-31219
V-31205
V-31206
V-31210
PCV-31213
V-31216
V-31211
PCV-31214
V-31217
V-31212
PCV-31215
V-31218
S-31207
S-31208
S-31209
V-31207
V-31208
V-31209
DRAIN
BOILER FEED PUMPS
STEAM DRUM
V-312113
V-312112
BOILER COLD FILL - SEE PSCo. DWG. 3-16.18 (C-2)
TO CONDENSATE STORAGE TANK 2" SEE PSCO DWG. 3-16.13 (A-3)
V-31230
V-31229
PCV-31228
V-31227
1/2" DRAIN
V-31224
ACID CLEANING
VENT
V-31223
V-31225
1/2" DRAIN
3RD STAGE HEATER E-31315
3RD STAGE HEATER E-31309
V-312049
V-312050
V-312051
V-312052
V-312053
PCV-312026
V-312054
TO 265" STEAM - SEE PSCO DWG. 3-16.23 SH. 1 (E-2)
FROM #1 BFP - SEE PSCO DWG. 3-16.21 (G-5)
Check this system
ISSUED TO FIELD
REVISION
REFERENCE DRAWINGS
NOMENCLATURE
3-16.2
PSCo
Approvals
ZUNI STEAM PLANT
UNIT 2 FLOW DIAGRAM
BOILER FEED SUCTION AND DISCHARGE
SCALE: NONE
Public Service Company of Colorado
GENERATION DESIGN/MECHANICAL
BY RML DATE 12/19/85
CKD. R.R.A. DATE 10/1/87
3-16.19
SHEET 1 OF 1
SYSTEM 31
FORM 300-24-3516
0733


Attachment No. TMF-1
Page 71 of 91
3-16.20
TURBINE NO. 1
TO EVAPORATOR FEED PUMPS SEE PSCO DWG. 3-16.18 (A-5)
FROM WEST WALL HTR., SEE PSCO. DWG. 13-16.14 (E-1)
FROM WEST WALL HTR. SUPPLY, SEE PSCO DWG. 3-16.14 (D-3)
DI TANKS
ABANDON
T-3102
T-3104 21,000 GAL
T-3101 NORTH EAST
T-3103
TO "C" TRANSFER PUMPS - SEE PSCO DWG. 3-16.18 (B-5)
TO EMG. GLAND SEAL - SEE PSCO DWG. 3-16.28 SH.1 (C-2)
TO "C" CONDENSATE HEADER - SEE PSCO DWG. 3-16.18 (F-1)
V-31152
CV-31151
FCV-31157
ABANDONNED IN PLACE
FCV-31167
V-31149
19TH + 20TH STAGE HEATER E-31119
18TH STAGE HEATER E-31118
Tie RO water into condensate pump suction
V-31148
TO GLAND SEAL TANK - SEE PSCO DWG. 3-16.28 SH.1 (K-2)
TO EMG. GLAND SEAL - SEE PSCO DWG. 3-16.28 SH.1 (H-1)
FROM R.O. UNIT SEE PSCO DWG 3-16.14 (K-3)
CONDENSER E-3101
V-31147
V-31135
FCV-31150 (RELOCATED)
V-31134
V-31132
V-31129
FCV-31130
V-31131
VENT
DRAIN
"B" DEAERATOR T-31102
"A" DEAERATOR T-31101
V-31155
V-31153
V-31156
V-31160
V-31161
V-31162
FCV-31163
V-3364
TO BOILER FEED PUMP HDR. SEE PSCO DWG 3-16.21 (A-4)
FROM WEST WALL HTR., SEE PSCO DWG. 13-16.14 (E-1)
TO BOILER FEED PUMP INLET HEADER, SEE PSCO DWG. 3-16.21 (B-2)
FROM DEAERATOR STORAGE TANK, SEE PSCO DWG 3-16.17 (F-3)
OPEN END
V-31154
V-31169
V-31168
INTERCONDENSER
STEAM JET AIR EJECTOR
AFTERCONDENSER
V-31139
FCV-31138
P-3101
V-31146
V-31144
V-31136
V-31137
V-31118
CV-31143
V-31140
FCV-31141
P-3102
V-31145
V-31117
CV-31142
CONDENSATE PUMPS
TO #1 GLAND SEAL TANK - SEE PSCO DWG. 3-16.28 SH.1 (K-1)
1/2" SEAL WATER
EMERG. TREATED WTR. TRAILER
V-3380
V-3381
2 1/2" HOSE
FROM "C" CONDENSATE TRANS. PUMPS, SEE PSCO DWG. 3-16.18 (E-3)
V-31122
FROM DRAIN TANK PUMP DISCHARGE, SEE PSCO DWG. 3-16.17 (E-5)
V-31121
WARM UP LINE FROM FEED PUMPS, SEE PSCO DWG. 3-16.21 (A-6)
RETURN FROM #1 & #2 GLAND SEALS
CV-31120
TO R.O. DISCHARGE LINE, SEE PSCO DWG. 3-16.14 (K-5)
V-3378
CV-3377
V-3376
CV-3375
P-31104
P-31103
FROM VBW MAINT. SHOP HTRS. SEE PSCO DWG 3-16.28 SHT.1 (L-4)
FROM REVERSE OSMOSIS SYSTEM. SEE PSCO DWG. 3-16.14 (K-6)
FROM BOILER FEED PUMP DRAINS. SEE PSCO DWG. 3-16.22 (E-7)
DRAIN
"B" LOW LEVEL TANK 51,600 GAL T-3106
"A" LOW LEVEL TANK 66,800 GAL. T-3105
FROM UNIT HEATERS, SEE PSCO DWG. 3-16.14 (B-7)
SPACE HEATER RETURN SEE PSCO DWG 3-16.17 (H-4)
NOMENCLATURE
TITLE
REFERENCE DRAWINGS
REVISED PER NEW WTR. TREATMENT SYS.
ISSUED TO FIELD
REVISION
ZUNI STEAM PLANT
UNIT 1
FLOW DIAGRAM
A+B CONDENSATE
Public Service Company of Colorado
GENERATION DESIGN/MECH.
SCALE: NONE
BY KAH DATE 1/16/86
CKD. RRA DATE 1/16/86
3-16.20
SHEET 1 OF 1
SYSTEM 31

3-16.21



ZUNI STEAM PLANT
UNIT 1 FLOW DIAGRAM
BOILER FEED SUCTION AND DISCHARGE

Public Service Company of Colorado

GENERATION DESIGN/MECH.

SCALE: NONE

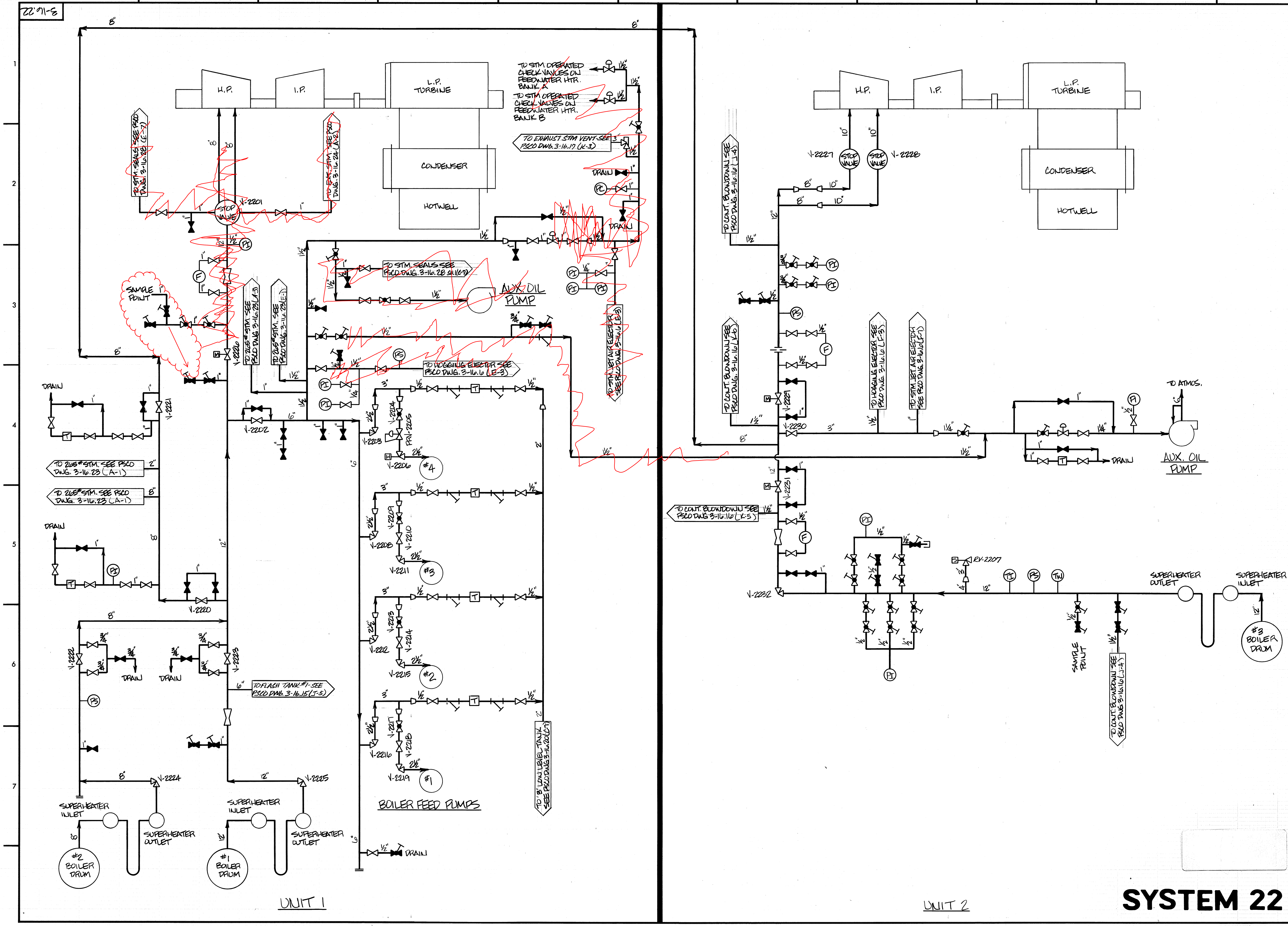
BY RML DATE 1/17/86
CKD. RPA DATE 1/17/86

3-16.21

SHEET 1 OF 1

REVISION: ISSUED TO FIELD

REFERENCE DRAWINGS: DWG. NO. 3-16.2 — MFGR. PSCO — TITLE NOMENCLATURE



REFERENCE DRAWINGS

DWG. NO.	MFGR.	TITLE
3-16.2	PSCO	NOMENCLATURE

REVISION

NO.	ZONE	DATE	BY	CK.	E	M	A-C	mf
					ISSUED TO FIELD			

Approvals: E, M, A-C

Public Service
Public Service Company of Colorado

ZUNI STEAM PLANT
UNITS 1 & 2
FLOW DIAGRAM
MAIN STEAM

SCALE: NONE

GENERATION DESIGN MECH.

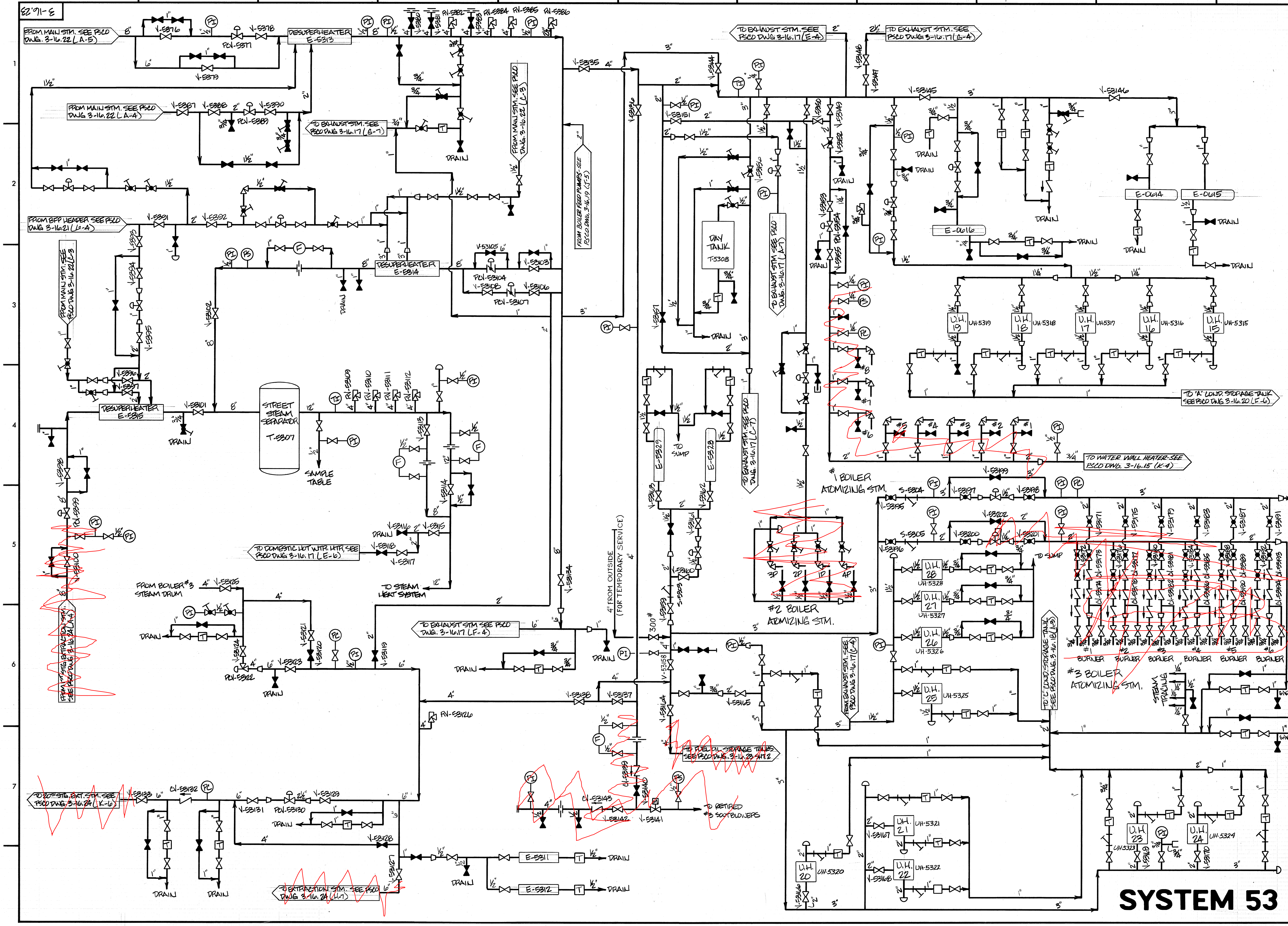
BY JEH DATE 2/9/87
CKD. RBA DATE 10/1/87

3-16.22

SHEET 1 OF 1

SYSTEM 22

FORM (A) 300-24-3516
0736



NO.	ZONE	DATE	BY	CK.	REVISION	E	M	A-C
		5/25/93	SS		ADDED 4" TEMPORARY PIPE FROM OUTSIDE			
		9/18/89	KW	7/87	ISSUED TO FIELD			

REFERENCE DRAWINGS

DWG. NO.	MFGR.	TITLE
3-16.2	PSCO	NOMENCLATURE

Approvals

ZUNI STEAM PLANT
UNITS 1 & 2
FLOW DIAGRAM
265# STEAM

GENERATION DESIGN | MECH. | SCALE: NONE

BY JEH DATE 3/21/67
CKD. RBA DATE 10/11/87

3-16.23

SHEET 1 OF 2

SYSTEM 53


3-16.23
FROM PLANT, SEE PSCO DWG. 3-16.23 SHT. 1 (G-7)
T-0601
T-0603
T-0602
E-0611-1
E-0611-2
E-0613-1
E-0613-2
E-0612-1
E-0612-2
PCV-53206
PCV-53209
PCV-53213
PCV-53216
PCV-53219
PCV-53222
PCV-53228
PCV-53225
V-53203
V-53204
V-53211
V-53240
V-53232
V-53241
SPILL PROT. TANK
VENT
DRAIN
TRUCK UNLOADING STATIONS
RAIL CAR UNLOADING STATIONS
UH-5327
UH-5330
U.H. 29
U.H. 30
TO "C" CONDENSATE STORAGE TANK SEE PSCO DWG 3-16.18 (A-5)
TO "C" COND. RETURN TANK
T-5304
P-5305
P-5306
CONDENSATE SUMP
System to stay as is
SYSTEM 53
REFERENCE DRAWINGS
DWG. NO. 3-16.2
MFGR. PSCO
TITLE NOMENCLATURE
REVISION
ISSUED TO FIELD
NO. ZONE DATE BY CK.
Approvals
E M A-C
ZUNI STEAM PLANT
UNIT 1 & 2
FLOW DIAGRAM
265# STEAM
SCALE: NONE
GENERATION DESIGN / MECH.
Public Service
Public Service Company of Colorado
BY JEH DATE 4/3/87
CKD. RRA DATE 10/1/87
3-16.23
SHEET 2 OF 2


3-16.24
TO ASH PIT. SEE PSCO DWG. 3-16.26 (C-6)
H.P. TURBINE
L.P. TURBINE
1ST STG.
5TH STG.
9TH STG.
13TH STG.
15TH STG.
17TH STG.
20TH STG.
FROM MAIN STM. SEE PSCO DWG. 3-16.22 (C-2)
TO CONDENSER
15TH STG. H.P. HTR.
20TH STG. H.P. HTR.
CONDENSER
E-5322
E-5323
TO EXH. STM. SEE DWG. 3-16.17 (F-5)
CV-53242
CV-53245
CV-53248
CV-53254
TO 265# STM. SEE PSCO DWG. 3-16.23 SHT. 1 (A-6)
CV-53256
V-53255
TO EXHAUST STM. SEE PSCO DWG. 3-16.17 (F-4)
TO EXHAUST STM. SEE PSCO DWG. 3-16.17 (G-5)
DRAIN
V-53243
V-53249
V-53246
TO EXHAUST STM. SEE PSCO DWG. 3-16.17 (H-4)
STEAM SEAL LEAK-OFF SEE PSCO DWG. 3-16.28 SH. 1 (E-7)
V-53247
V-53244
5TH STG. H.P. HTR.
E-5316
V-53250
V-53251
V-53252
V-53253
9TH STG. H.P. HTR. NO. 9A
E-5317
9TH STG. H.P. HTR. NO. 9B
E-5318
E-5319
13TH STG. H.P. HTR. NO. 13A
V-53257
V-53258
V-53259
V-53260
E-5320
13TH STG. H.P. HTR. NO. 13B
E-5321
18TH STG. H.P. HTR.
V-53261
UNIT 1
H.P. TURBINE
L.P. TURBINE
5TH STG.
15TH STG.
20TH STG.
23RD STG.
26TH STG.
26TH STG. H.P. HTR.
CONDENSER
E-5327
V-53262
V-53266
V-53274
V-53278
V-53263
V-53267
V-53275
V-53279
VENT
TO HOTWELL
STM. CHEST DRAIN
CV-53276
DRAIN
FROM EXHAUST STM. SEE PSCO DWG. 3-16.17 (D-4)
V-53280
V-53281
V-53282
TO LOW LOAD FLASH TANK SEE PSCO DWG. 3-16.23 (C-3)
FROM EXHAUST STM. SEE PSCO DWG. 3-16.17 (D-4)
CV-53264
V-53265
15TH STG. H.P. HTR.
E-5325
E-5324
9TH STG. H.P. HTR.
23RD STG. H.P. HTR.
E-5326
FROM EXHAUST STM. SEE PSCO DWG. 3-16.17 (D-4)
CV-53272
V-53273
V-53268
CV-53269
V-53271
TO UNIT 2 DEAERATOR SEE PSCO DWG. 3-16.18 (B-1)
TO EVAPORATOR. SEE PSCO DWG. 3-16.18 (F-6)
V-53270
V-53271
FROM 265# STM SEE PSCO DWG. 3-16.23 SHT 1 (C-7)
TO EXHAUST STM SEE PSCO DWG. 3-16.17 (D-7)
FROM 265# STM. SEE PSCO DWG. 3-16.23 SHT 1 (A-7)
UNIT 2
This system will be out of service
SYSTEM 53
DRAWINGS
REFERENCE
3-16.2 PSCO NOMENCLATURE
DWG. NO. MFGR. TITLE
REVISIONS
ISSUED TO FIELD
Approvals
Public Service
Public Service Company of Colorado
ZUNI STEAM PLANT
UNIT 1 & 2
FLOW DIAGRAM
EXTRACTION STEAM
GENERATION DESIGN MECH.
SCALE: NONE
BY JEH DATE 4/8/87
CKD. RBA DATE 10/1/87
3-16.24
SHEET 1 OF 1

Attachment 4 – Steam Load Profiles

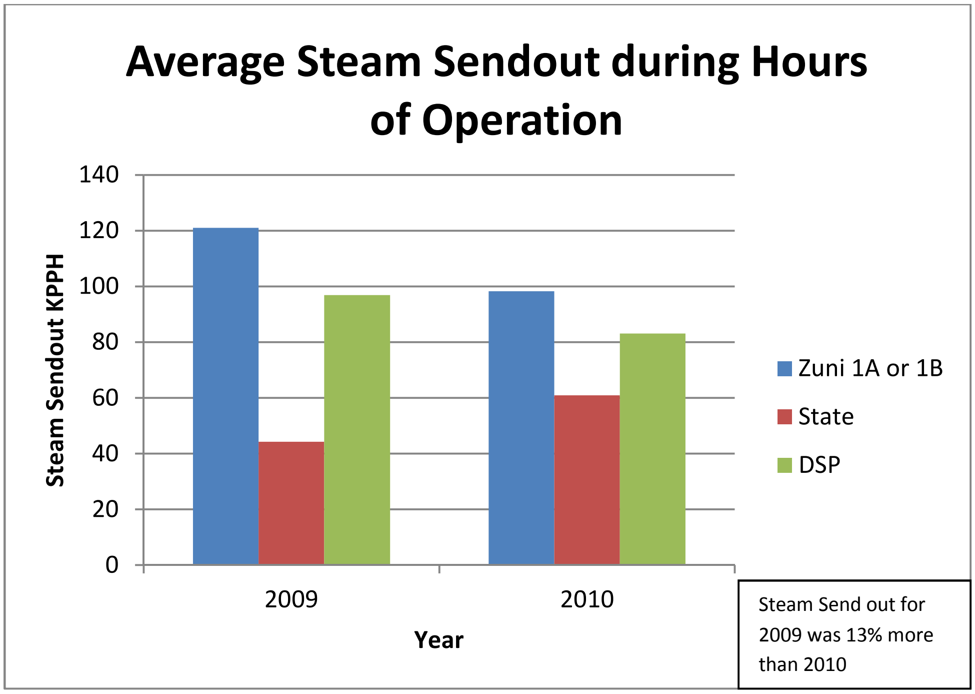


Figure A5-2

The data for 2009 and 2009 show that Zuni produces a higher average of steam when it operates than either DSP or State, with State operating relatively more in 2010.

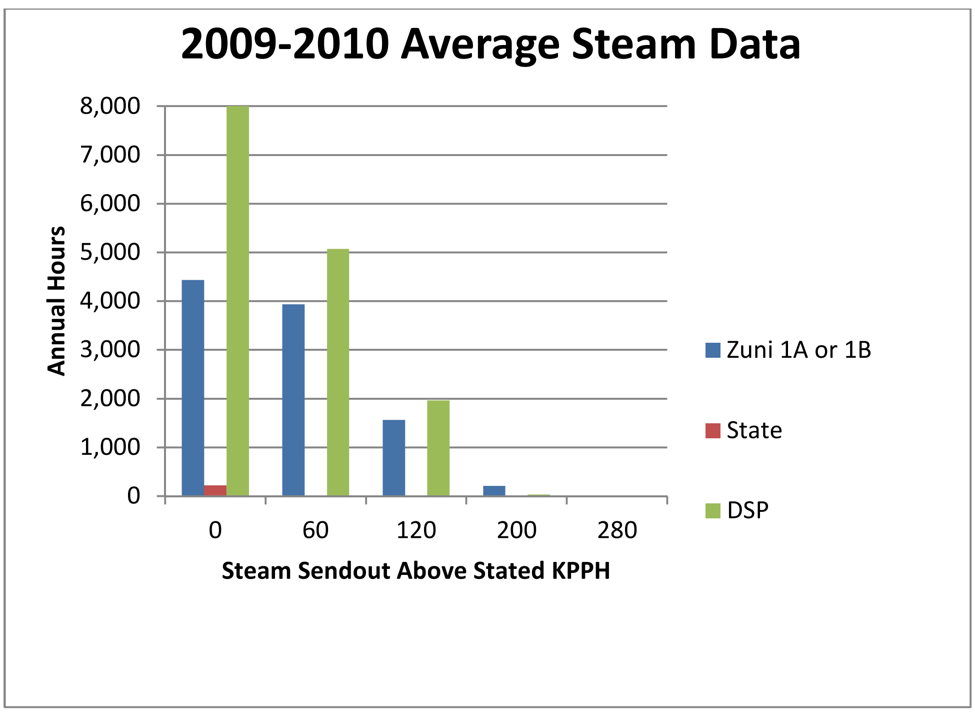
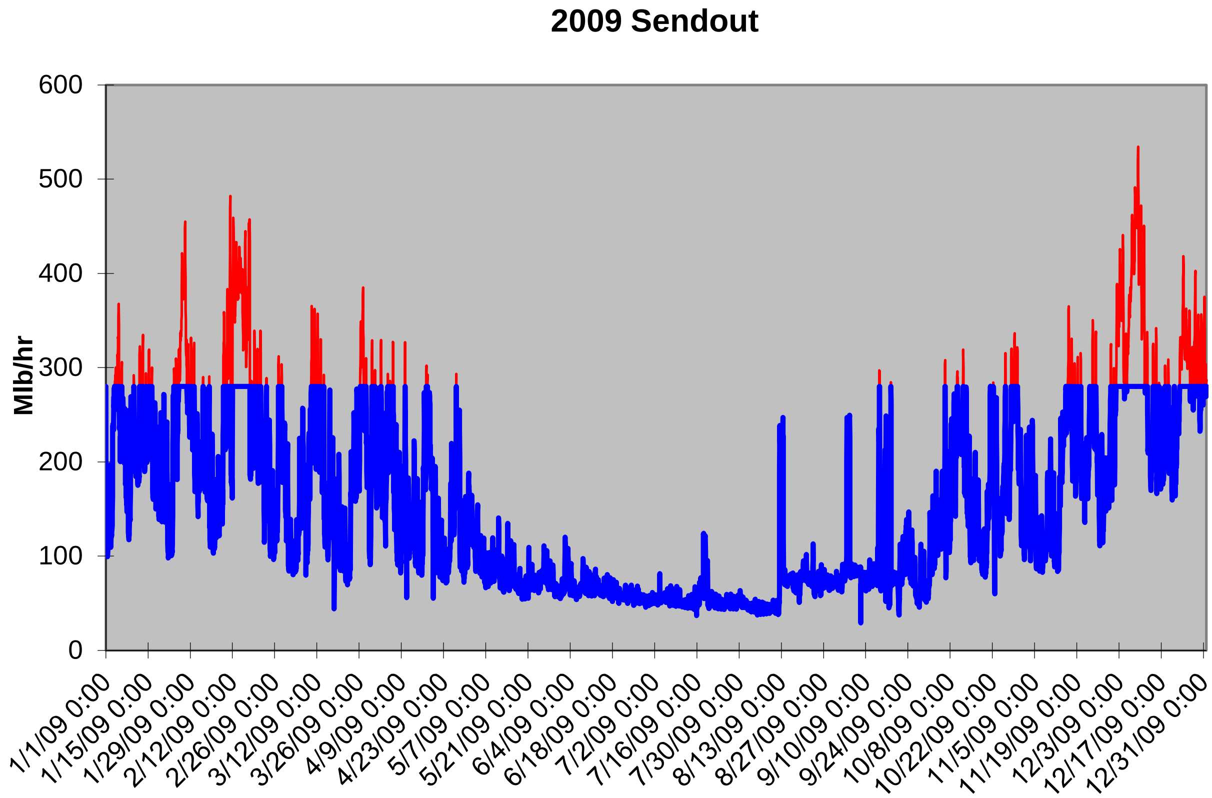
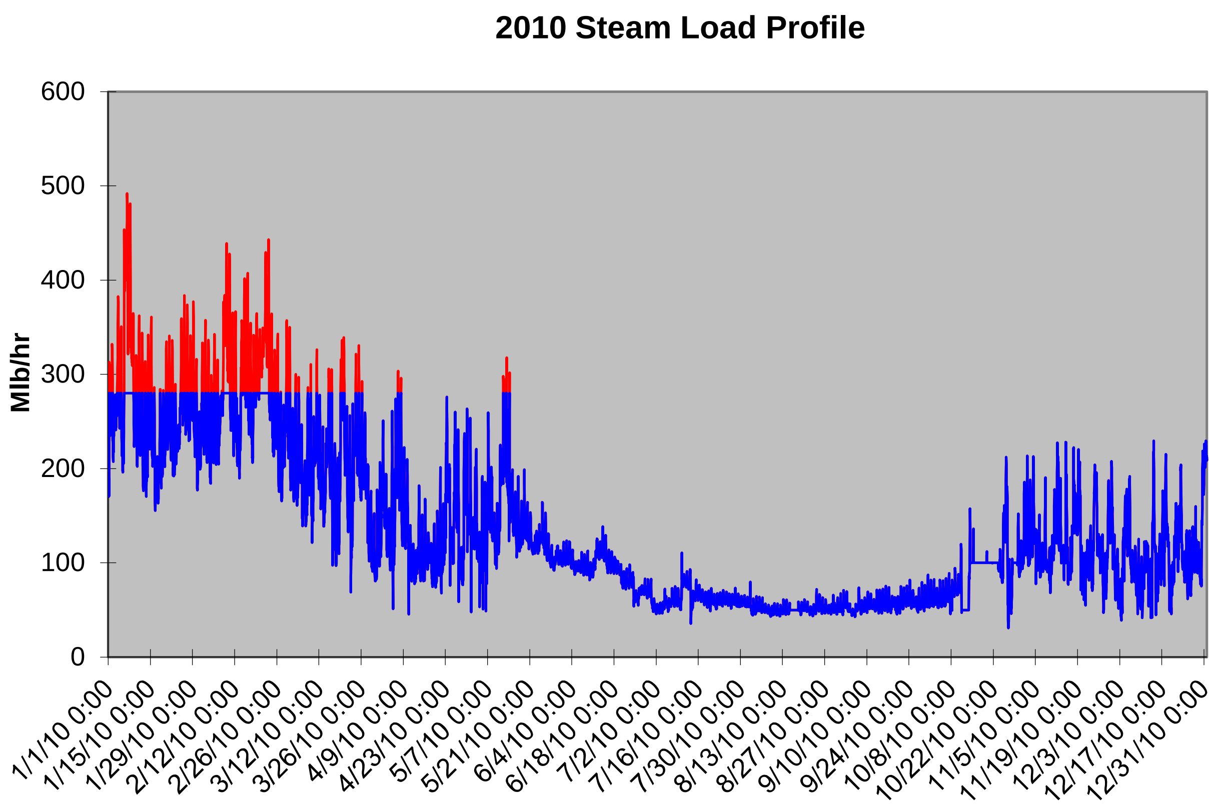


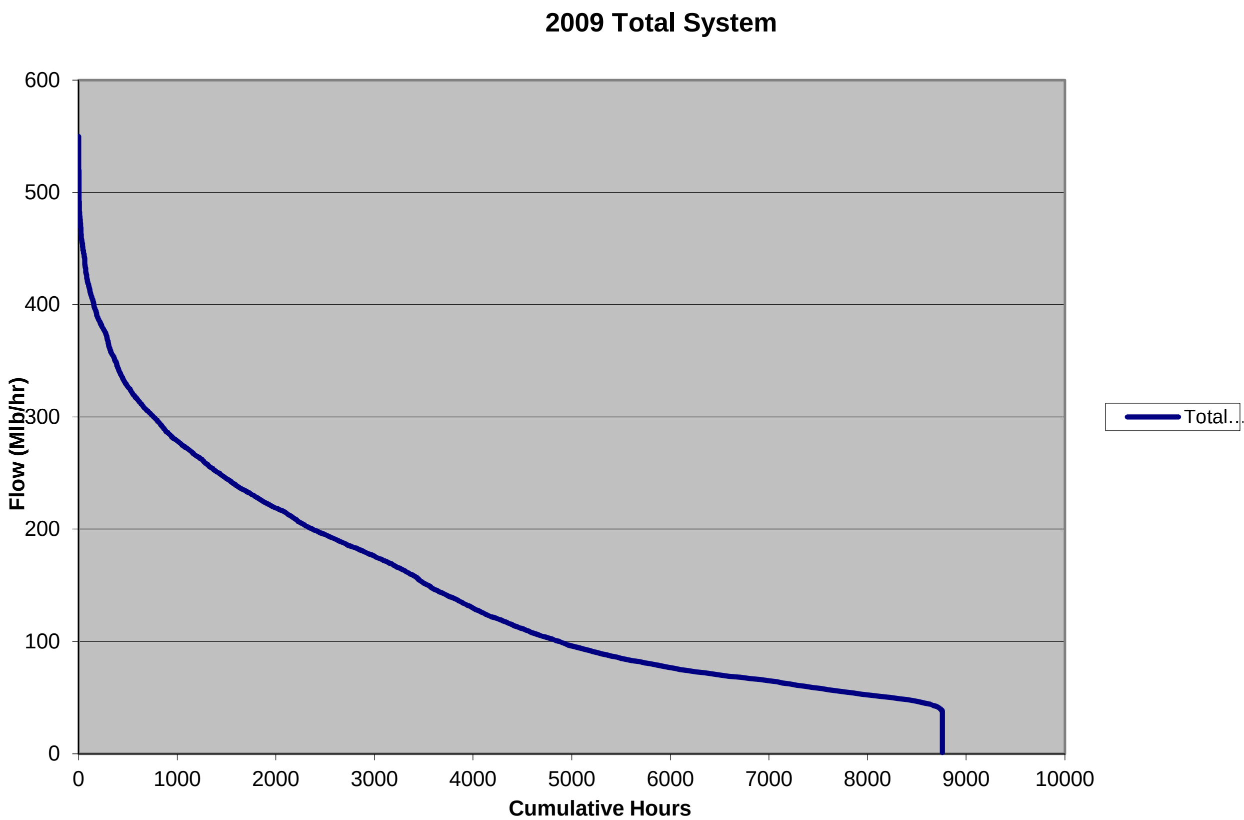
Figure A5-3

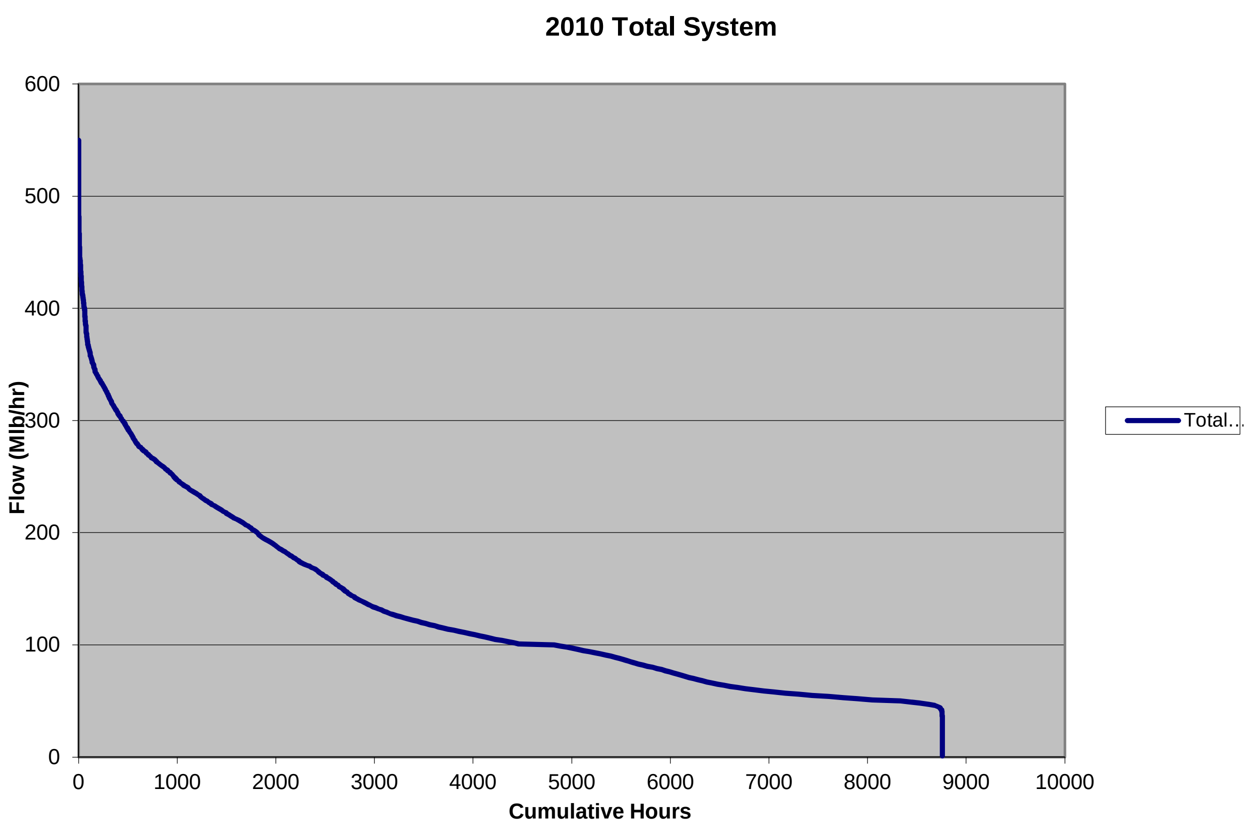
DSP operates more hours, especially during summer months, than either Zuni or State, as it is used for system pressure control. For 2009, the total steam sendout less than 60 kpph was 1,441 hours, and for 2010, it was 1,959 hours.





The data for 2009 steam system operation shows that the peaks occur during the colder winter months, but there is still demand in the summer for various customer uses. The weather during the autumn of 2010 was significantly warmer than during 2009.

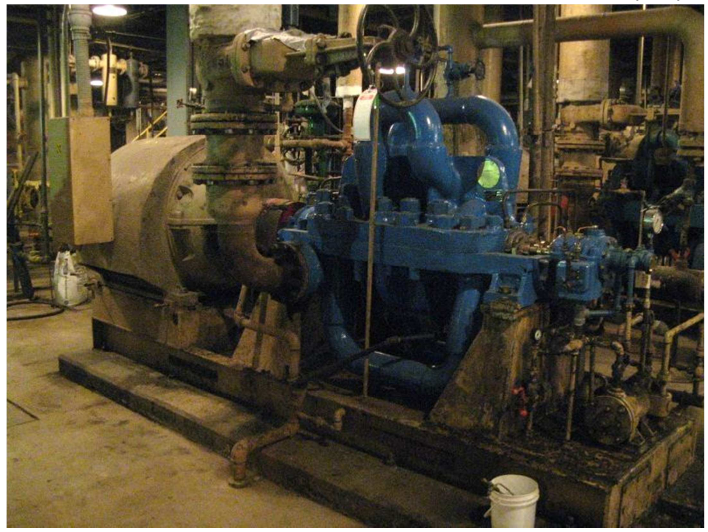




These charts show that the demand is 100,000 lb/hr or less for about one half of the annual hours. The demand exceeds the supply if Zuni were experiencing a forced outage for up to 10% of the annual hours, usually during the coldest periods, when gas supply could also be curtailed.

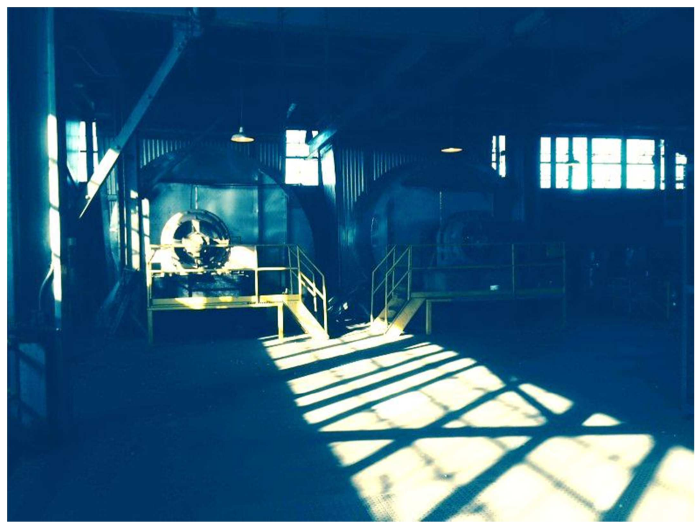
Attachment 5 – Plant Photos

Unit 1A – Boiler Feed Pumps and Turbines

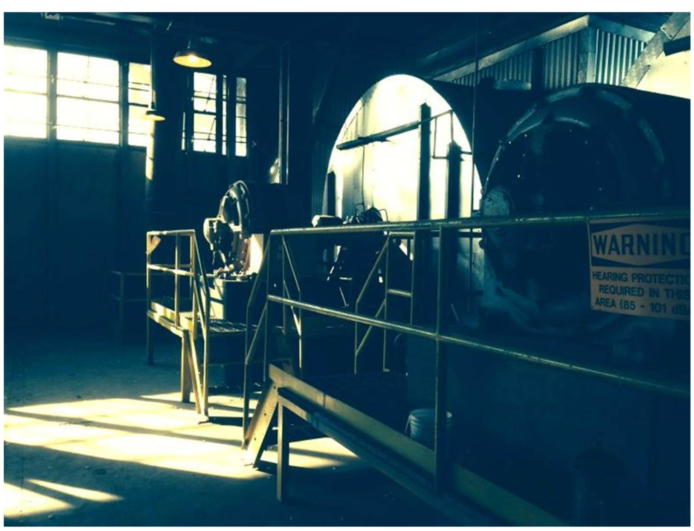


Unit 2 – Boiler Feed Pumps

Unit 1A – ID Fan Motor



Unit 1A – ID Fans



Unit 1A – ID Fans and Motors

Unit 1B – Feed Water Heaters

Unit 2 – Coal silo and coal pipes to burners

Sump outside Unit 2

Gas Burner Area – boiler 2

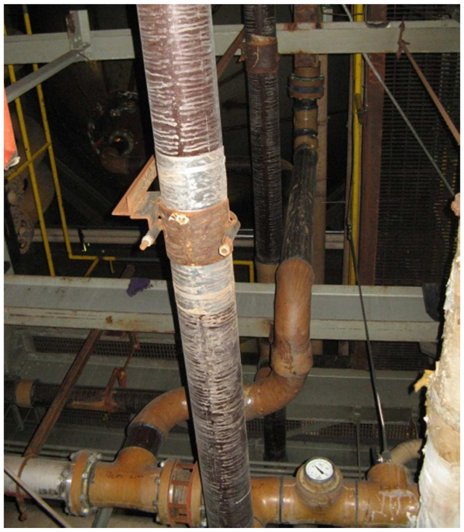
Unit 2 - TG Set

Condensate Transfer Pump

Condensate Transfer Pump

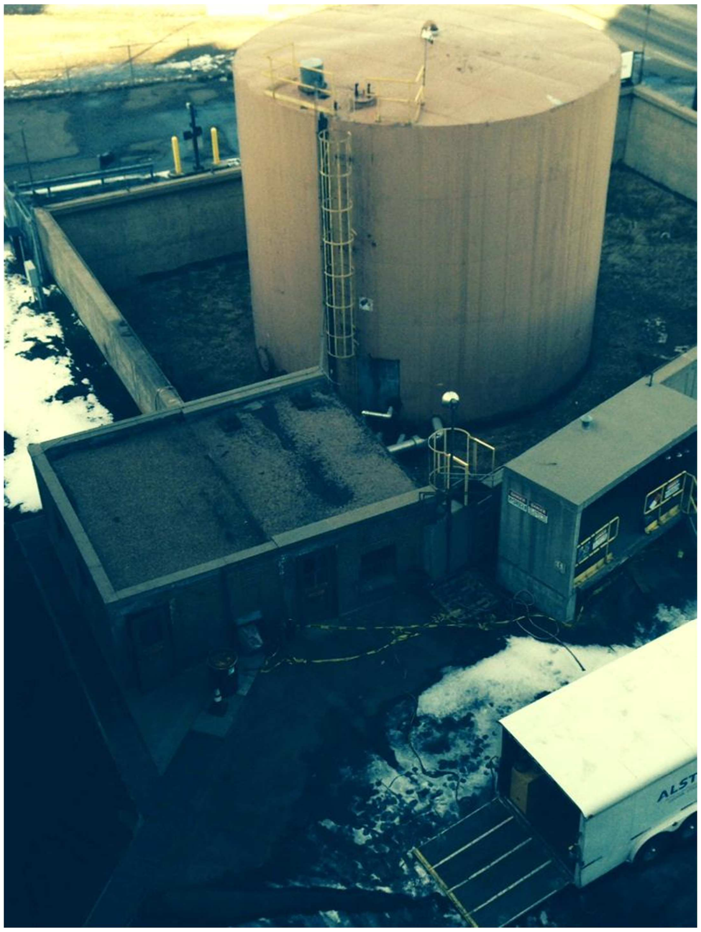
Unit 2 – Fan

Service Water Cooling Tower



Plant from Parking Lot looking South with Unit 2 Stack

Fibercast Piping near Condensate Transfer Pump



Unit 2 - #6 Oil Tank and Heater Building

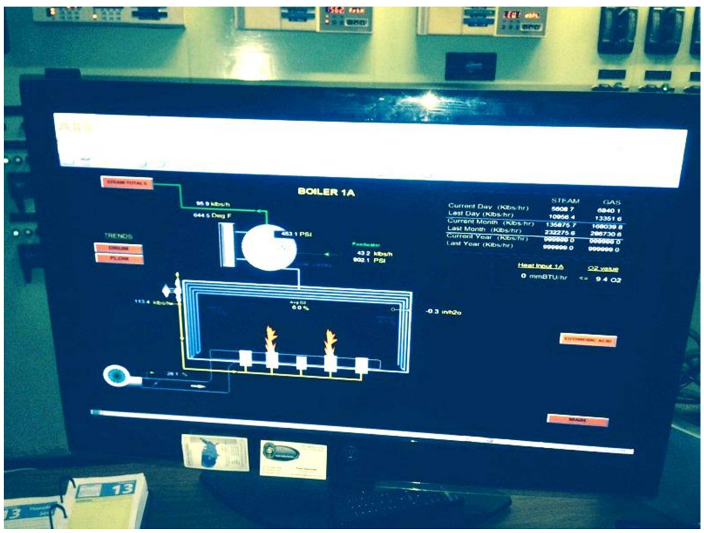
Unit 1 – Stack from Parking Lot looking South

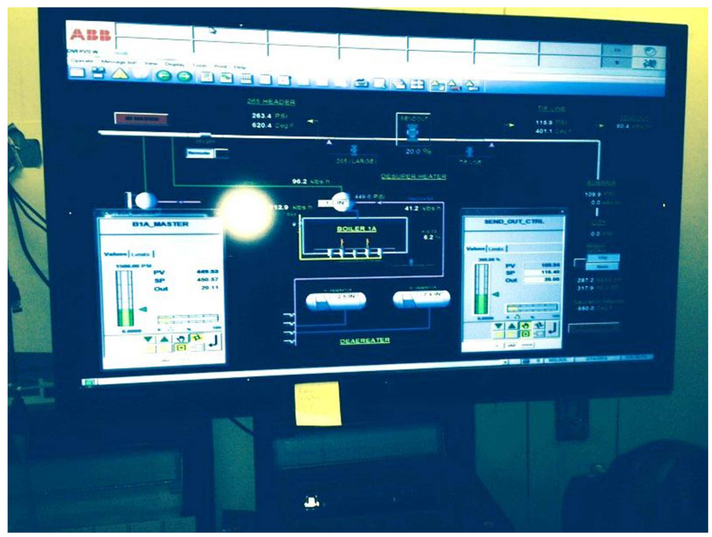
Unit 2 – South Side of Boiler

Unit 2 – HV Lines to Switchyard and Stack

Control Room Screen 1- Showing both Boilers

Control Room Screen 2 – showing Both Boilers





Control Room Screen 3 – Showing 1A operation

Control Room Screen 4 – Showing 1A operation

Attachment 6 – Public Utility Commission (PUC) Testimony (Testimony by Jan Wagner in Proceeding No. 12A-1264ST)

System Overview and Current Customer Base

The Company's district steam system is a regulated business. The system includes three steam boiler stations (which includes the Electric Department's Zuni Station) and a distribution system, enabling the Company to deliver steam to 133 steam customers at any given time with a current steam peak of 560,000 pounds per hour (pph). Approximately 16 miles of steam transmission and distribution piping form the Company's thermal system service grid covering downtown Denver. (See Section 6.0, Steam System Map). On this system, the Company operates seven major regulating stations and over 250 vaults, containing valving, expansion joints, and associated piping, throughout downtown Denver. Each customer site is metered by equipment which varies from front-end (steam) meters to back-end (condensate) meters. The condensate is ultimately delivered into the City of Denver's storm drainage system whether or not it is used by the customer for any secondary applications.

The Company does not have any plans to expand its downtown Denver steam system in any material way or to establish any new district steam systems elsewhere in Colorado. The Company is obligated to connect new customers requesting steam service pursuant to the terms of the Service Connection and Main Extension Policy set forth in the Company's tariff. From a practical standpoint, however, due to the high cost of constructing new steam mains and laterals in downtown Denver, any new customers would likely be located in close proximity to the Company's existing steam mains. Accordingly, while the Company stands ready to extend service to new customers, including customers wishing to convert from self-supply arrangements to central steam service, we do not anticipate expanding our current service area footprint in the foreseeable future. As indicated by our rate analysis, existing customers benefit from some expansion of steam service customer base and it is the Company's intention to continue to reach out to potential customers in the Sun Valley and Central Platte area as well as brownfield development within our current footprint to ensure that they are aware of the availability of steam utility service. The Company does not currently plan to increase steam production capacity beyond the three facilities discussed in this report.

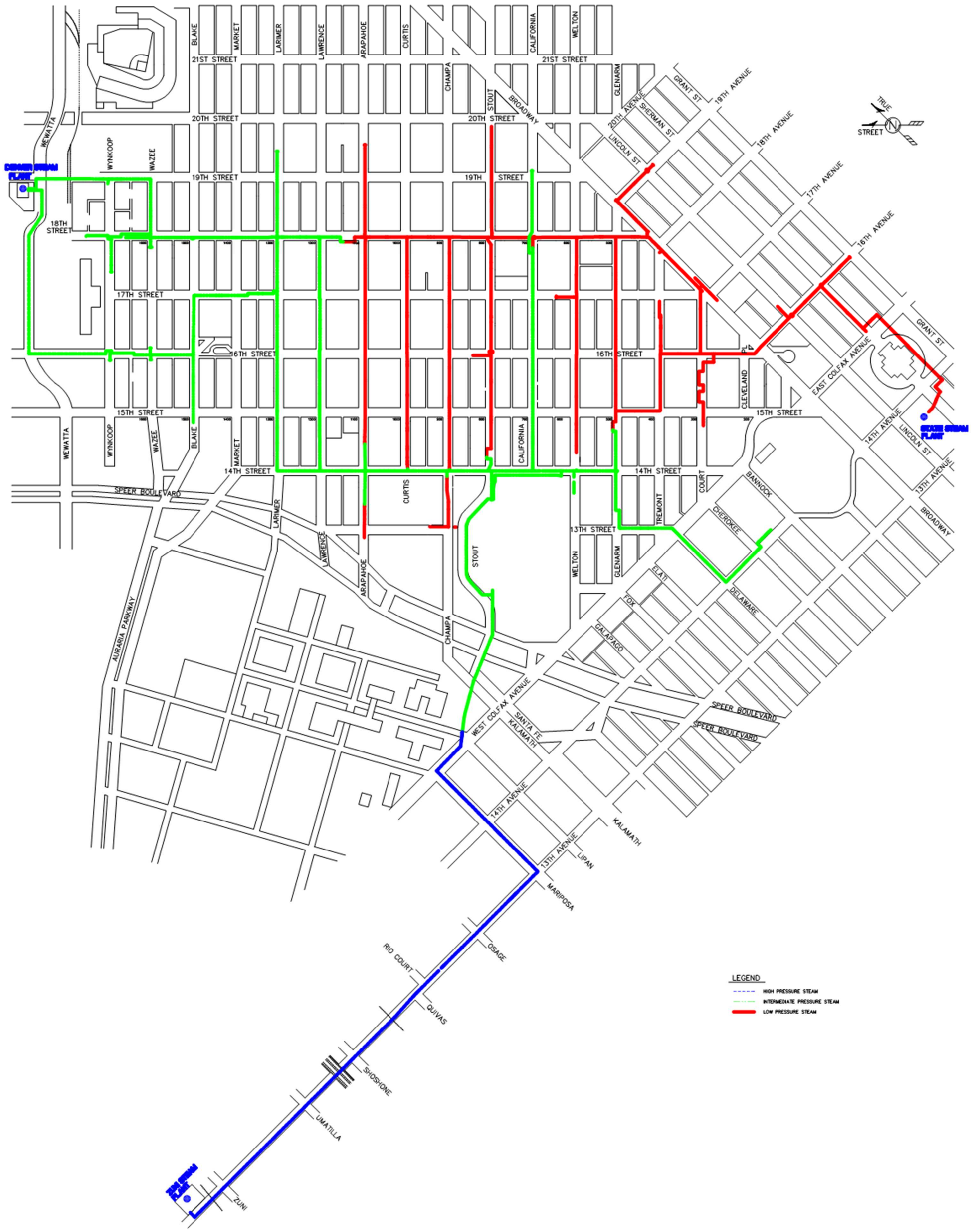
As of September 2012, the Company had 133 metered steam customers representing a variety of customer types, including commercial office buildings, residential buildings, hotels, retail establishments, restaurants, city, state and federal governmental buildings, including the State of Colorado's Capitol Complex, the City and County of Denver (including the Colorado Convention Center, Denver Art Museum, Webb Municipal Office Building and the new Denver Justice Center), and the campus of the Auraria Higher Education Center.

While steam customers periodically have come and gone, the Company's steam system customer base has remained at a stable 130-140 count over the last decade. Customers use steam primarily for space heating, but also for heating domestic water, food service operations, laundries, and industrial processes, such as coin washing at the Denver Mint. In 2011, the Company provided a total of 999,651 Mlbs (or thousand pounds) of steam service. In 2012, production numbers were only 872,279 Mlbs, due in large part to lower than normal heating degree days. The Denver Steam system supplies space heating to approximately 80 million square feet of commercial, residential, and governmental space. The market penetration of steam service in downtown Denver is about 50 percent of the commercial space of buildings in close proximity to our distribution system. A breakdown of customer types on the Denver system is shown in Section 6.0.

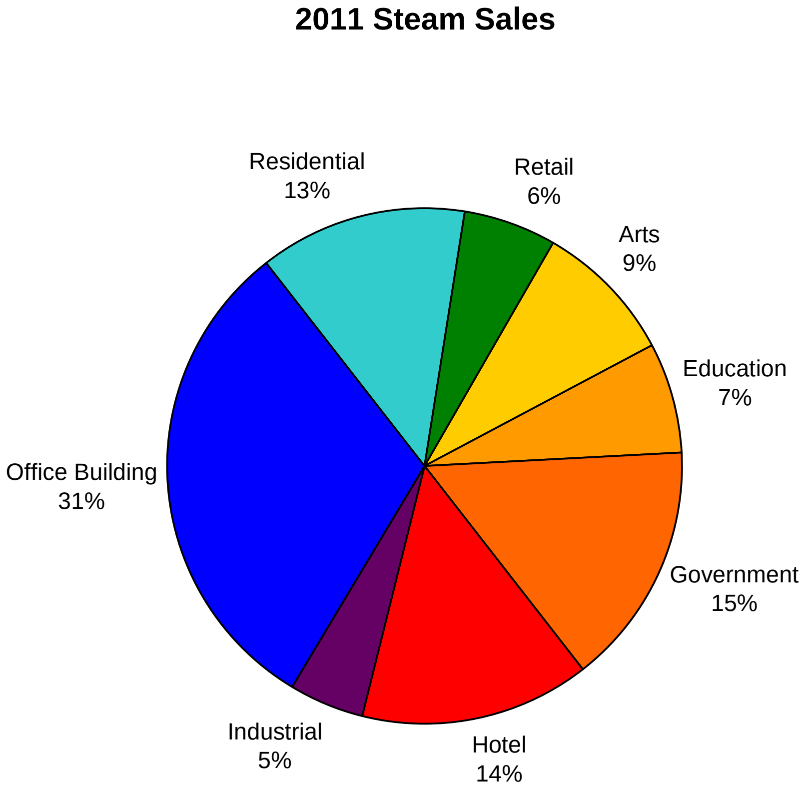
The Company would note that there are approximately 6000 district energy systems around the world according to the International District Energy Association ("IDEA"), the industry trade association. There are many district energy members in the United States. New York City, Indianapolis, and Washington, D.C. are among the largest city-based systems. Public Service's steam business has a long history, having been originally incorporated as the Denver City Steam Heating Company in December 1879. The system is the oldest, continuously operating commercial steam utility in the world, according to IDEA. Examples of other district energy systems within Colorado are Denver International Airport, University of Colorado Boulder Campus, Coors Brewery in Golden, Air Force Academy, and the IBM Boulder Campus. Prior to joining our system, both the State of Colorado Capitol Complex and the City of Denver owned and operated their own district energy systems. The advantage of district energy is that heating services are generated in a central location and are distributed to customer locations allowing greater seasonal efficiencies, less capital investment and O&M expenses than individual buildings.

6.0 Illustrations

Steam System Map



Customer Type



EVALUATION OF FUTURE OPTIONS FOR PUBLIC SERVICE COMPANY'S STEAM SUPPLY BUSINESS IN DENVER

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

SUMMARY OF ZACHRY ENGINEERING PARTICIPATION

Zachry Engineering Corporation ("ZEC") assisted Public Service of Colorado ("Public Service" or "Company"), at their request, to gather information for development of this report as part of an ongoing effort led by Public Service. The study objective was to define and evaluate the available options for supplying steam to the Denver Steam customers after the retirement of the electric generation equipment at the Zuni Generating Station at the end of 2015. For each option, a conceptual description was developed, a capital cost estimate was prepared by factoring the previous estimate for the Sun Valley Steam Center, O&M estimates were prepared, and financial impacts were calculated over either a 5-year period or a 30-year period, depending on the useful lifetime of the option.

ZEC's role in this effort included meeting with the plant personnel to gather input on the current operational status of the existing steam plant equipment, developing the option descriptions and the capital cost estimates for all options, with help from Public Service as needed, and to assist Public Service is presenting the O&M cost estimates and the revenue requirements calculations. ZEC also provided editorial and technical assistance during the drafting and final production of the report. The report was primarily drafted by Jack Darnell of ZEC under the direction of Tim Farmer and Stephen Kutska of Public Service.

Xcel Energy℠

Evaluation of Future Options For Public Service Company's Steam Supply Business in Denver

Prepared by: Tim Farmer
Jack Darnell
Stephen Kutska
Scott Weldon

Date: September 25, 2014

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Executive Summary

This report was developed in response to the PUC direction for a more complete analysis of the options available as alternatives to the implementation of the Sun Valley Steam Center as originally proposed by Public Service Company of Colorado ("Public Service" or "Company"). Public Service had requested a CPCN from the Colorado Public Utilities Commission ("PUC") to construct Sun Valley in order to replace capacity at its aging Zuni facility and meet future downtown Denver steam system demand in a reliable manner. In a proceeding last year the PUC denied that CPCN, and directed Public Service to investigate other options to meet demand, and to provide an assessment of its steam business. Public Service developed a range of feasible options, and evaluated each option at a conceptual level of detail based on existing information and engineering judgment. Public Service also analyzed each option for the resulting Net Present Value (NPV). Public Service also prepared capital cost and Operating and Maintenance ("O&M") cost estimates for each option, which are attachments to this report. Finally, Public Service considered the impact on system capacity, as well as how confident the company was in the cost estimates for and the reliability of each option.

The Options lettered A-K below address long-term steam supply issues. The "L"and "Z" options address temporary, short-term solutions, including modifications to Zuni Station to allow it to continue in steam production mode for the next 3-5 years only. The "K" option to tie the State Steam Plant boilers into Public Service Company's intermediate-pressure ("IP") steam distribution system is actually part of both the short-term and long-term supply solution, but included as a long-term supply option because that upgrade will be permanent. The full short-term and long-term options that Public Service evaluated are as follows:

- A. Original Sun Valley Steam Center
- B. Reduced Scope Sun Valley Energy Center
- C. Two New Packaged Boilers in Existing Zuni Building
- D. One New Packaged Boiler in Existing Zuni Building
- E. Major Upgrade of Zuni 1A Boiler for Reliable Long-Term Operation
- F. Major Upgrade of Zuni 2 Boiler for Reliable Long-Term Operation
- G. One New Packaged Boiler at existing Cherokee Steam Plant
- H. Two or more Used Boilers in Existing Zuni Building
- I. Take over Operation of Non Company-Owned Boilers and tie into IP System
- J. One New Packaged Boiler at Denver Steam Plant ("DSP")
- K. Tie State Steam Plant Boiler into IP Steam System
- L. Several Rental Boilers in Temporary Building adjacent to existing Zuni building
- Z1. Minimum Investment for Near-Term Continued Use of Zuni 1A
- Z2. Minimum Investment for Near-Term Continued Use of Zuni 2
- Z1+Z2. Minimum Investment for Near-Term Continued Use of Zuni 1A and 2

The recommended strategy going forward includes the following components:

a) In the short-term (up to 5 years from the end of 2015), it appears that continued operation of both Zuni boilers in a steam-only mode (Option Z1+Z2), which includes the minimum investment to solve known issues and increase the probability of reliable operation, is the low-cost strategy. This will maintain the capability to meet historic steam demand peaks. At the same time, the connection of the State boiler to the IP distribution system (instead of the low pressure (LP) system as currently configured) will make a needed contribution that would improve system reliability and provide operational flexibility. It would allow the State Steam Plant (SSP) boiler to supply the system demand during the Denver Steam Plant (DSP) annual maintenance outage, and minimize the operating hours of the Zuni boilers except during the winter peak season, resulting in better system efficiency and reduced risk from Zuni operation.

b) If the system demand changes as a result of the new rate structure, to a value significantly below the current demand, then the most likely candidate for additional capacity without Zuni is a third package boiler at DSP (Option J), in addition to the SSP Upgrade (Option K) to cover DSP's maintenance outage. Since the continued operation of the Zuni boilers with minimum investment is practical for only 3-5 more years, if that, and the development of a new boiler is estimated to take several years, it is prudent to begin the proactive development of the third boiler at DSP with immediate air modeling to define the necessary stack dimensions, development of a conceptual layout and cost estimate for the addition, and removal of the underground #6 oil tank.

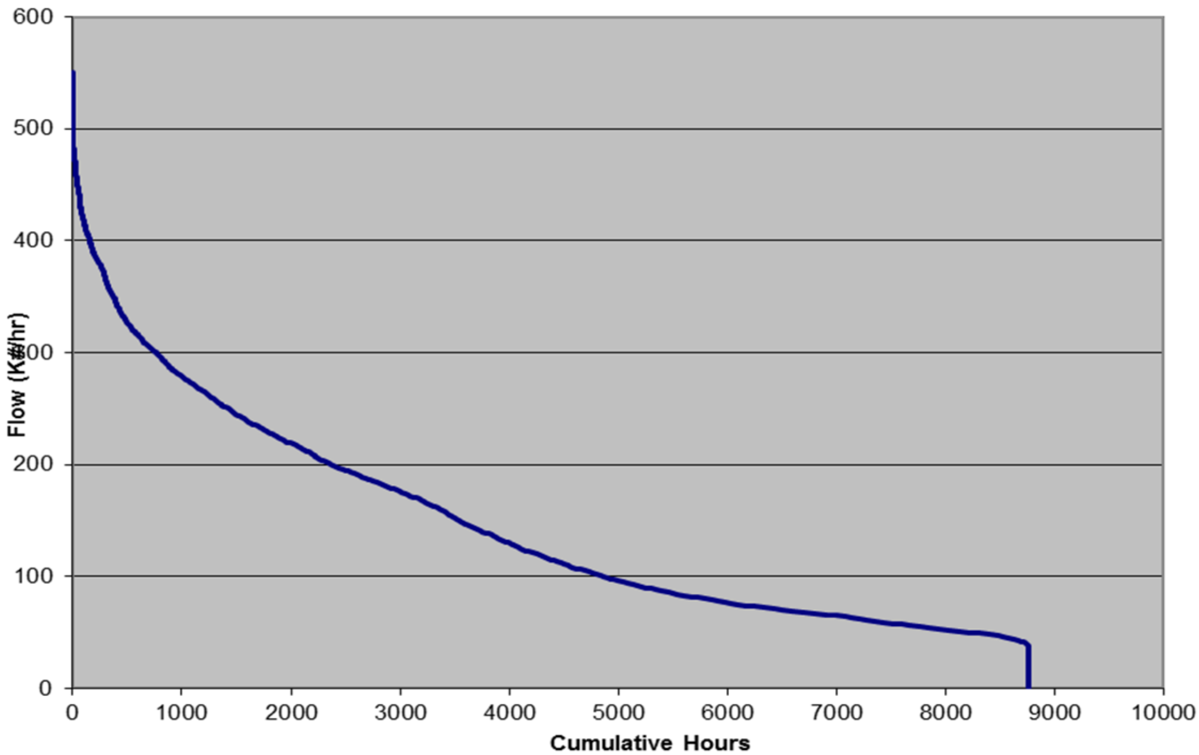
c) After Public Service determines the required long-term production demand with more confidence, in the event that peak demand remains near historic levels, then other options may present better long-term supply solutions. Those options not involving continued use of the Zuni building or equipment have an O&M cost advantage , and the reduced-scope Sun Valley facility (Option B) or a combination of new boilers at DSP (Option J) and Cherokee Steam (Option G) are probably the leading candidates.

1. Objective of Evaluation

There is uncertainty about the future peak and seasonal steam demand from customers in the downtown Denver service area due to the additional cost the steam business will incur with the retirement of the electrical generation equipment at the Zuni Station, scheduled for the end of 2015. Also, Public Service's proposed new rate structure for the steam supply business including a demand charge will increase steam costs for some customers. Public Service is considering the alternatives to allow the market to adjust to a new demand level prior to any significant capital investment in new steam supply equipment, and may consider limited operation of the two Zuni boilers for steam supply until the market demand stabilizes and Public Service can better gauge the most prudent long-term investment.

An important factor in the historical reliability of service of the steam system is the installed capacity of the steam supply boilers evaluated against the maximum winter and summer demand. Figure 1-1 shows the load duration curve for 2009, as an example.

Figure 1-1 Steam Demand Load Duration Curve for 2009

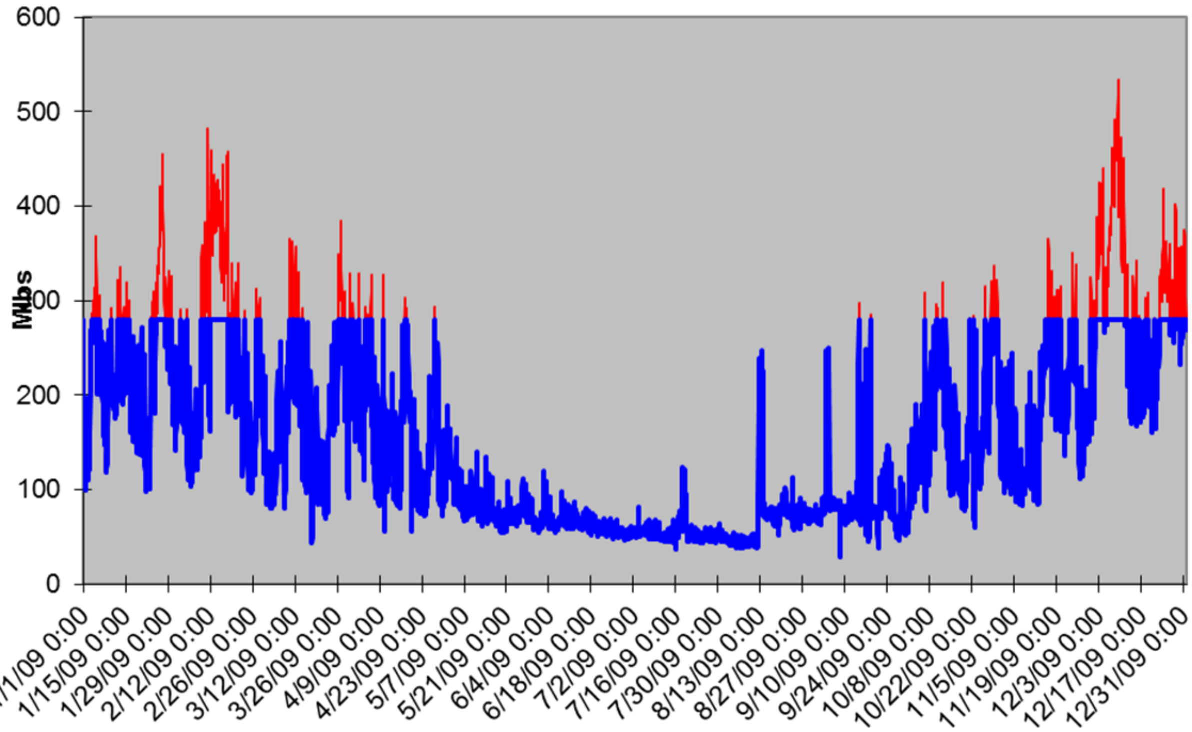


The two large Zuni plant boilers are capable of delivering up to 280,000 pounds per hour ("pph") or 280 Mlb/hour of steam to the distribution system, and either boiler can provide that sendout capacity. However, the 280,000 pph is the maximum sendout available even though the boilers can provide more capacity due to the steam tie line connecting these boilers to the distribution system. The Denver Steam Plant has two boilers; the larger boiler is capable of delivering 160,000 pph, while the smaller boiler is capable of delivering 150,000 pph. DSP operates at a typical sendout capacity of approximately 260,000 pph of steam supply, since it is usually controlled to keep the pressure in the distribution system constant, with a peak sendout capacity of 310,000 pph. The State Steam Plant, which unlike the other plants is connected to the LP distribution system, can typically produce 80,000 pph, but has capacity to produce 120,000 pph if it could operate at intermediate pressure, which is a future prospect once this part of the distribution system is upgraded. The total current system capacity under normal winter operation is:

Zuni Station	280,000 pph	Either Unit 1A or Unit 2 Operating
Denver Steam Plant	260,000 pph	Two Boilers Operating
State Steam Plant	80,000 pph	One Boiler Operating
Total Capacity	620,000 pph	One Zuni Boiler and all other boilers.

The maximum historical demand of 500 to 600 Mlb/hour can be supplied even when the larger DSP unit (unit 1; 120,000 pph and Unit 2; 140,000 pph) is out of service, except for a few hours during the winter peak. As shown in Figure 1-2, during the summer period, each of the four largest boilers can provide the entire system capacity requirement of 60,000 to 80,000 pph, which allows the planned outage of each unit for annual maintenance to be performed in an efficient manner on a predictable schedule.

Figure 1-2 Hourly Total Steam Sendout for 2009



The Zuni equipment has exceeded its normally expected service lifetime, and should prudently be retired from service and replaced by modern equipment with lower emissions and higher efficiency. As Zuni's equipment gets older, the risk of failure increases exponentially. The uncertainty surrounding failure of the Zuni equipment is a primary driver in the push to remove this plant from service.

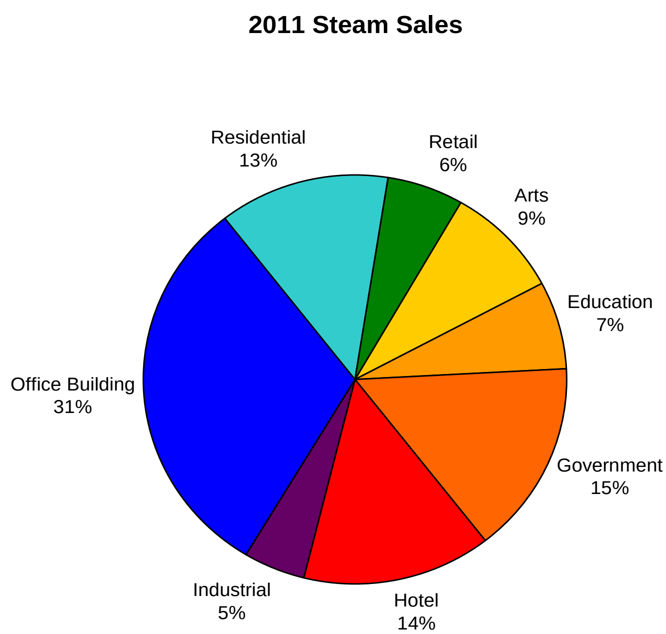
2. Background on Previous and Current PUC Interactions

On December 12, 2012, Public Service filed an Application seeking a Certificate of Public Convenience and Necessity (CPCN) to construct the proposed new Sun Valley Steam Center (SVSC) for its steam utility. SVSC would have included two package boilers with steam production capacity of 300 thousand pph as well as supporting water treatment facilities, a boiler feedwater system, a control system, electrical equipment, and a building to house both the equipment and the operating, maintenance, and management personnel for the plant. The new facility was proposed to replace the steam capacity being provided by Zuni Electric Generating Station (Zuni Station) following its expected retirement at the end of 2015, and would be located on a portion of the Zuni Station property.

The SVSC is referred to as Option A in Section 3 of this report, and during rebuttal testimony before the PUC, a modified version of the SVSC concept with a smaller building and other changes was developed by Public Service, with a savings of approximately $3 million from the original SVSC that had an estimated capital cost of $29 million. The modified SVSC is referred to as Option B in Section 3 of this report.

Currently the steam system has 129 metered steam customers representing a variety of customer types, and provides steam utility service to commercial office buildings; residential buildings; hotels; retail establishments; restaurants; city, state, and federal governmental buildings (including the State of Colorado's Capitol Complex); the City and County of Denver (including the Colorado Convention Center, Denver Art Museum, Webb Municipal Office Building, and the new Denver Justice Center); and the campus of the Auraria Higher Education Center. The system peak (winter) demand is 500,000 – 600,000 pph of intermediate and low pressure steam. The minimum system demand occurs in the summer, and is approximately 60,000 – 80,000 pph total. The breakdown among customer types is illustrated for 2011 in Figure 2-1 below.

Figure 2-1



To meet its burden of proof for approval of a CPCN to construct and operate a facility, a utility must establish the following by preponderance of the evidence: (a) a present or future need for the facility; (b) that existing facilities are not reasonably adequate and available to meet that need; and (c) the utility has evaluated alternatives to the proposed facility. The impact on utility rates, and the magnitude of underlying operating, maintenance, and capital costs, is also relevant to the public interest analysis.

In its decision, C13-1549 dated November 26, 2013, the PUC denied Public Service's SVSC CPCN application without prejudice, citing the following issues:

- Public Service has not shown that there is a present or future need for the proposed size of the SVSC facility, particularly given the uncertainty of the viability of the steam utility in the future. The proposed costs and potential rate increases for steam customers, even accounting for a subsidy under the Regulatory Plan, are material and not supported by the purported benefits of the new facility.

- A more thorough investigation of alternatives to the SVSC is also necessary. These alternatives, as suggested by the parties, may include: adding capacity at other existing facilities; investigating building lease options; working with the Denver Redevelopment Authority or other customers to provide space for a boiler; and potential distributed steam generation and co-location options. We require Public Service to submit an analysis to determine the correct boiler sizes and capacities, and their associated costs, for a range of customer attrition and growth possibilities. An assessment of how the steam system may operate at a substantially reduced level, perhaps utilizing only the remaining boilers at other Company facilities, after the Zuni Station is closed, should also be considered, as advocated by Staff. Public Service is directed to complete a future needs assessment and a plan to meet those needs.
- Public Service must provide the Commission a thorough analysis of the causal relationship between increased steam rates and customer erosion. Therefore, as part of the required future needs assessment, Public Service shall conduct a detailed survey of its steam customers addressing their needs, options, and preferences for utility service.

Public Service has also filed a Phase 1 and Phase 2 rate adjustment request with the PUC to modify steam rates to reflect current costs. The Phase 1 rate case was filed in late 2012, and resolved approximately a year later in proceeding 13AL-1402ST with a General Rate Schedule Adjustment (GRSA) of 27.24 percent increase, based on a rate structure with a Service and Facilities Charge and a Commodity Charge. The Phase 1 increase was the result of general price increases from 2006 – 2012 where the rates had not been adjusted.

Subsequently, Public Service filed Advice Letter No. 124-Steam with the PUC on June 26, 2014 to change the rate structure to a three part billing basis, with the System & Facilities charge, a Consumption Charge to replace the Commodity Charge, and a Demand Charge based on maximum demand during the system peak load during the 4 am to 10 am period for five winter months (November through March). Public Service based this request on a comparison to this structure for the electric and natural gas rate structures already in place, and the desire to send better price signals to the customers based on the actual costs for supplying steam to them. Public Service has explained that this new rate structure would affect customers differently, with the largest increases for those customers with a high peak period demand but a relatively low average demand. Conversely, customers with a relatively constant demand would likely see a decrease in annual costs with the new structure. For the overall majority of customers, the impact of annual costs was projected to be -15% to +30%, with a few customers likely experiencing a much larger increase in percentage terms. Public Service also illustrated this impact with an analysis of customers with load factors of 10 to 50%. For example, an office building, with occupancy of approximately 50 of the 168 hours in each week would likely see an increase in annual costs, while a hotel which uses steam for a variety of more regular and ongoing uses including laundry and cooking might be more likely to see lower annual costs.

Public Service hired a consultant to survey its customers to determine their likely response to the change in rate structure. Once Public Service knows which customers have elected to join or leave the system, and can better evaluate the load profiles of those customers who remain on the system, and their response to the new rate structure, Public Service will be in a better position to project future expected peak system demand. This in turn will help guide the type and size of new facilities necessary to replace the Zuni boilers while maintaining reliable operation of the steam system to support the remaining and potential new customers.

3. Options under Consideration

For the period following the removal of the Zuni Unit 2 electric generation equipment from service at the end of 2015, Public Service is evaluating a number of options to continue supporting the Denver steam supply business in an efficient and reliable manner. It is assumed that the two boilers at Denver Steam Plant (DSP1 and DSP2) and the one boiler at the State Steam Plant will continue operation in the existing configuration (unless identified otherwise for a specific option). Until another option can be developed, it is also assumed that operation of the existing Zuni boiler plant could continue short-term. As a basis for developing capital and O&M overall cost estimates, a description for each option is provided at a summary level of detail. Each option is presented as a stand-alone project that was evaluated using a financial analysis based on existing steam demand parameters as well as a range of lower system demand profiles.

Option A – Original Sun Valley Steam Center

Sited on part of the Zuni plant property south of 13th Street, this new facility would consist of two packaged water-tube boilers, each rated at a minimum of 160,000 pph sendout. It would also include the necessary support equipment for the boilers, such as forced-draft fans, boiler feedwater pumps, exhaust stacks, deaerators, water treatment for 100% of the steaming capacity, water and fuel oil tanks, control systems, and other supporting systems and equipment necessary for a stand-alone steam supply facility. The primary fuel supply would be natural gas, with #2 oil as a backup during times when natural gas may be curtailed. It also includes a building to house most of the equipment, including office and shop facilities to support the operation and maintenance of the facility. The Sun Valley facility would be interconnected to existing service lines for gas, electric, city water and sewer supply, as well as steam sendout, but would otherwise be independent of the existing Zuni equipment. The construction of the Sun Valley facility would not require demolition of the Zuni plant to provide space, but would require the removal of some minor equipment that now sits on the location of the new building.

Together the two boilers could supply the total IP system sendout capacity of 280,000 pph at this location (limited by the tie line connection) as well as the in-plant wintertime steam requirements, and either boiler could provide 160,000 pph sendout to support the entire system capacity during the summer season including the outage of other boilers for maintenance. This facility would be a complete replacement for the existing Zuni boiler plant, and would be optimized for steam supply service.

Compared to earlier estimates presented to the PUC, the latest estimate presented in this report retrofits changes identified in Option B on contracting approach, Public Service indirect costs and contingency, and elimination of the redundant steam sendout connection. This option has the most detailed cost estimate quantities, and was used to develop many aspects of the estimates for the other options as appropriate.

Option B – Reduced Scope Sun Valley Steam Center

This option is the same as Option A except for a reduction in office and facility space. The building space is reduced by approximately 50%, and assumes that other existing facilities will continue to be used for office and shop functions.

The steam supply capacity would be the same as Option A.

Option C – Two New Package Boilers in Existing Zuni Building

In an attempt to reduce the cost of the new facility by eliminating the cost of the new Sun Valley building, the two new package boilers with economizers would be placed along with new auxiliary equipment in the existing Zuni turbine building, and some of the existing Zuni auxiliary systems would be reused with modifications as necessary. Both existing Zuni boilers would be decommissioned. The baseline concept is to duct the boiler exhaust to one of the existing stacks, but a new common steel stack at least 100 feet tall could also be used and may be more acceptable to the neighbors. New auxiliary equipment would include water treatment vessels and pumps (utilizing existing water storage capacity), boiler feed pumps and deaerators, forced draft fans, and connection for blowdown to the city sewer. The electrical system and the control system would be upgraded for better reliability to reduce operator involvement. Significant modifications to the existing piping would be made to accommodate the new equipment. A new roof would be needed on the building, along with some local reinforcement of the turbine hall floor under the packaged boilers. The backup fuel would be converted to #2 oil as at DSP, with a new tank and supply pumps. No significant changes would be necessary to the offices, shops or control room.

The existing steam turbine deck would be utilized to set and support the new boilers. The two (2) steam turbines would be demolished and the material will be sold for scrap. For the purposes of this estimate, the cost for demolishing the existing steam turbines and the value for scrap would be a net zero. The steam supply capacity would be very similar to Option A, and the maximum sendout is limited by the steam line to downtown.

Option D – One New Package Boiler in Existing Zuni Building

This option includes half the new equipment in Option C above. The new package boiler would have a maximum sendout capacity of approximately 160,000 pph.

Option E – Major Upgrade of Zuni Unit 1A Boiler for Reliable Long-Term Operation

This option does not involve the addition of any new boiler capacity, instead it represents the continued operation of Zuni Boiler 1A for another 30 years. Note that the refurbishment of Zuni with new boilers means an entire rebuild of the plant. If this option were to be the selected choice, we would essentially have a “new” plant that comes at a higher cost than the construction of even the Sun Valley Steam Center.

Based partly on an evaluation by Babcock & Wilcox (B&W), the necessary modifications for Boiler 1A which are not realistically viable due to the risks of modifying and old facility; include replacement of the boiler feed pumps, replacement of the burners and burner management system, replacing the control system, adding a CEMS, upgrading to new switchgear, transformers, and motor control centers, repairs to the Unit 1 stack, and piping modifications, including a new sewer connection. It is also assumed that additional the O&M requirements grow each year for at least 10 years in order to keep the support systems and the boiler operational and fairly reliable since much of the equipment has reached its useful lifetime.

The steam supply capacity for Unit 1A would be the same as the current output (60,000 to 280,000 pph), which is between 15 to 75% of its original design rating. Note that this plant would continue to have a higher average heat rate than the other system boilers resulting in lower efficiency.

Option F – Major Upgrade of Zuni Unit 2 Boiler for Reliable Long-Term Operation

Similar modifications and annual investment for Unit 2 which are also not realistically viable due to the risks of modifying and old facility; are listed for Option E above would be required, except for the stack. Based on B&W's recommendations, some more significant boiler modifications to allow Unit 2 to operate well below design pressure due to the tie line limitation and load are included. A new connection for blowdown to the city sewer would be also be required for this option. The deaerator is also recommended for replacement.

The steam supply capacity for Unit 2 would be the same as the current output (60,000 to 280,000 pph), which is between 9 to 44% of the original design rating. This unit would also have a higher average heat rate than the other system boilers and thus lower efficiency.

Option G – One New Package Boiler at the City of Denver's existing Cherokee Steam Plant

This Option assumes that a new package boiler and auxiliary equipment and systems would be installed in the existing Cherokee Steam Plant building, which is owned by the City of Denver, which still contains the retired equipment from the former Denver plant. This would involve extensive modifications to a building with historic designation, along with necessary asbestos mitigation, to allow the retired equipment to be removed and the new equipment installed. The new boiler would have a maximum capacity of 130,000 pph steam sendout, due to the size of the existing building and the resulting allowable footprint for the new boiler. Modifications to all of the gas, steam, water, and sewer connections would be required. A new control system would also be required. New fuel oil and treated water tanks would be located outside the building. A number of simplifying assumptions were made in order to develop the cost estimate for this option so more specific data would be needed in order to fully evaluate the construction and refurbishment costs of this site.

In addition, the 10" diameter IP steam distribution line in the immediate area may limit sendout, but no modeling at the maximum capacity has been performed. Replacement of the buried pipe with a larger size for four city blocks could add another $4,000,000 to the capital cost. This option covers the option to place a boiler at any generic site in the city within the footprint of our steam line with the exception of the historic designation of the building and its associated costs.

The steam supply capacity is estimated to be a maximum of 130,000 pph.

Option H – Two or more Used Package Boilers in Existing Zuni Building

This option is similar to Option C (two new boilers at Zuni) above, with the exception that the characteristics of the used boilers will determine the type and capacity of the support systems. Each used boiler will be assessed for condition, and allowances were made in the estimate for any necessary modifications, repairs, or upgrades necessary to the boilers. The potential cost savings for used boilers is small due to the number of other changes necessary to connect the boilers to the support equipment and sendout connection. The maximum sendout capacity is expected to be 280,000 pph, and the minimum capacity with the largest used boiler out of service is assumed to be at least 150,000 pph. We were not able to assess the availability of used boilers with the necessary capacity to align with our timeframe given the uncertainty in when we would or could execute this option.

Option I – Take over Operation of Existing Boilers at a Non Company-Owned site and tie into the IP steam system

The Company located some existing boilers at a large hotel site that were not being fully utilized to supply steam to that facility. There were three boilers at the site each with 40 Mlb/hour of sendout capacity. These boilers are older and the exact condition of this equipment turned out to be difficult to assess due to the age of the boilers and the limited documentation and history that the owners could provide. In order to truly determine the condition of the equipment, we would have to spend several thousand dollars to do inspections, testing and other activity. However, this Option involves the addition of 80,000 pph of new winter sendout to the IP system. Public Service would lease the existing boilers and support equipment from another entity, and take over operating responsibility for the boiler systems. Public Service would supply both that entity with the needed steam (10,000 to 35,000 pph), as well as manage the sendout to meet steam system requirements. A new boiler operation control system would be necessary, and each of the necessary support systems in place would be evaluated for operation of the three 40,000 pph boilers simultaneously, and upgrades would be needed to make this possible.

With a summer maximum sendout from the other site of about 100,000 pph, this option would represent a relatively small addition to the supply system. Because of the large number of uncertainties associated with this option, the poor documentation of the equipment, and the age of the installed equipment (boilers built in 1957), this option is a possibility but would take an extensive effort to evaluate all the issues and develop a more accurate cost estimate than we were able to produce from our limited evaluation of the boilers. It should be noted that no allowance for eventual replacement of the existing boilers has been included, and the installation of any replacement boilers would involve a major project in the 4th level basement of an existing operating facility. Capital and O&M cost estimates have been developed, but the high level of uncertainty made the final financial analysis too uncertain to include in the final results.

Option J – One New Package Boiler at Denver Steam Plant

This Option involves the addition of a new package boiler and necessary support equipment to supplement the existing two boilers at DSP. The site is congested, and removal of the buried #6 oil tank south of the existing building was included to allow sufficient space without blocking the drive through access for delivery of #2 oil and water treatment chemicals. The existing building and the street setback limits, along with the rapid development of surrounding high rise buildings, present development challenges since a new stack would be required. The new building would house the new boiler and the associated auxiliary equipment. The new boiler would have a maximum sendout capacity of about 160,000 pph.

The overall sendout capacity of the two steam distribution lines from DSP will support the combined operation of the three boilers simultaneously. Water and gas systems will be checked for adequacy for this condition, and upgraded as needed. This option has advantages in the O&M requirements, since sharing of responsibility at the same site is reasonable, compared to keeping a separate staff 24 hours/day at Zuni (for example).

Option K – Tie State Boiler into IP Steam System

This Option involves only the reconfiguration of the steam sendout connection and associated valves from the LP to the IP system for the State Steam Plant. This would allow the existing 120,000 pph boiler to deliver all of its capacity to the steam supply system, rather than its typical 80,000 pph due to the demand from the LP system customers. The boiler support systems at this facility are capable of supporting the higher operating level. This boiler is the most recent addition to the system having been placed into service in 2005.

The steam supply capacity for the State boiler would be approximately 120,000 pph, or an increase of 40,000 pph from the current situation. Another significant advantage of this option is to allow the State boiler to supply the entire steam demand during the summer DSP maintenance outage, which is not possible now since the State Steam Plant is only connected to the LP distribution system. Upgrading SSP in this fashion would also allow more hours of operation at SSP, which could in turn limit the hours of operation at the less efficient Zuni, and minimize the risk of Zuni equipment failure.

Option L – Several Rental Boilers in a Temporary Building adjacent to existing Zuni Building

During the transition period where rate adjustments might cause existing steam customers to explore other options and possibly reduce overall steam system demand, a strategy of minimal capital investment for about 2 years was also investigated. Several trailer-mounted rental boilers with stack mounted economizers along with the trailer-mounted auxiliary equipment necessary to support them (water softening equipment, deaerator, and feedwater pumps), would be rented as needed to meet system demands and maintenance outage requirements. It is assumed that two boilers would be rented year round, and an additional two boilers would be rented between mid-October and mid-April to assist in meeting peak demands. The necessary support equipment would also be rented, and the only non-rental expense would be that necessary to connect these rental units to the existing water, gas, backup #2 oil fuel in a new tank, and compressed air supplies, as well as the control systems, steam sendout connections, and city sewer connection. Per Capital Asset Accounting, during the rental period all costs incurred supporting the rental equipment (water, fuel, electric, sewer, etc.) would be considered O&M costs and applied in the first year.

Each boiler would have a sendout capacity of at least 65,000 pph. A header would connect the boiler exhaust connections with a new free-standing metal exhaust stack that is at least 100 feet tall. A temporary fabric or metal building, adjacent to the existing Zuni building, would be used for an equipment enclosure for the boilers and auxiliary equipment trailers, to allow equipment freeze protection and a conditioned environment for the operators.

After the temporary rental period, it is possible that some or all of the rental boilers could be purchased or that we could implement other options resulting in a long term steam supply approach sized to match the expected long term steam demand. The lease purchase option for rental boilers was not evaluated at this time.

Option Z1 and Z2 – Minimum Investment for Near-Term Continued Use of the Zuni Boilers

For the past several years, the need to use the Zuni units for electricity production has declined to the point that Unit 1A turbine generator was retired at the end of 2009 and Unit 2 turbine generator and associated equipment is expected to be retired at the end of 2015. Operation of the Unit 1A boiler for steam supply has continued since its electric capability was retired, and the same approach is possible for Unit 2. This option is not ideal for long-term operations, from either a reliability or operation cost perspective, but with a modest amount of investment to solve known issues and update the controls systems to safely meet current operator needs, it is estimated that another 3-5 years of operation is possible for each unit. We fully assessed the Zuni equipment in 2014 to determine the minimum necessary investment reasonable to maintain the current confidence in the safe use of these systems to supply steam in the winter peak periods and to allow the planned outages of the DSP and State boilers during the summer period. It should be noted that there is a significant risk of unplanned equipment failure with these options given the age of the equipment at Zuni, most of the equipment being past it service life when the potential for failure exponentially increases with time. There was a recent Unit 2 boiler feed pump outage, recent tube leaks in both boilers, and electrical equipment failure causing outages during the recent DSP annual maintenance outage, which is when this equipment was most needed. No significant electrical modifications were included in the cost estimates, but equipment problems would be repaired as they occur, resulting in additional expense. Additionally, we assume that there will be higher O&M expenses for each unit to deal with added equipment and roof leakage problems.

Option Z1 is the incremental upgrade of the Unit 1A equipment identified as critical needs in the assessment recently completed. The operators have relatively high confidence in the operation of this unit due to recent experience in the steam-only mode.

Option Z2 is the incremental upgrade of the Unit 2 equipment identified as critical needs in the assessment completed in early 2014. Because this unit has not been used to support the district steam system for many years, except sparingly when absolutely needed, the operators have a lower confidence in the ability of this unit to operate reliably in steam-only mode. This unit has to be operated at less than 50% of its design capacity due to the limitation of the steam sendout line, and typical steam supply from Zuni in recent years has averaged 120,000 pph (18% of design capacity). B&W recommended a number of modifications to improve the life of this unit due to possible circulation and superheater flow balance problems, but these B&W recommended boiler modification costs have not been included because of the 5 year operational assumption for this option.

A further Option Z1+Z2 was also developed in order to lower the impact of a catastrophic failure of one of the two units, which lowers the risk of system problems in the event of a major equipment failure on either Unit 1A or Unit 2. This would include both Options Z1 and Z2, keeping both boilers operating for the next five years. Because there are common components that are included in each of the above options, there is a capital cost savings compared to the sum of Option Z1 and Option Z2, and the same operating expenses are expected to cover both units.

4. Capital Cost Estimates for Options

In 2011, a significant effort was undertaken to develop an initial design for the Sun Valley Steam Center, with layout drawings, equipment lists and sizing, budgetary quotations, quantity takeoffs, and a detailed estimate. This effort resulted in detailed estimates accurate to +/- 20%. This estimate is the basis for a set of factored estimates for the other options, using engineering judgment as well as a similar basis and format.

The details of the estimates are presented in Attachment 1 to this report, and are confidential . A summary of the SVSC estimate was presented to the PUC in a summary table, and a similar table was developed for the modified SVSC estimate. Table 4-1 presents the same information for all the options in a level of detail similar to that used for the public filing on SVSC. Some adjustments were made in the approach to allow easier adjustment of indirect costs among the options of varying size and complexity, and escalation of the SVSC costs was included from the 2011 original estimate to mid-2014 dollars. As a result, the bottom line totals for the SVSC option are not an exact match to those already presented to the PUC because of this updating, but the differences can be explained.

Table 4-1 Capital Cost Estimates Summary

(This table summarizes the detail of individual estimates (mid-2014 dollars) in Attachment 1).

Option A **Original Sun Valley Steam Center**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$29.8M

Option B **Reduced Scope Sun Valley Steam Center**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted] [redacted]	[redacted] [redacted]
Plant Equipment	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]
Balance of Plant	[redacted] [redacted]	[redacted] [redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted] [redacted]
Owner indirect costs	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]
Contingency				[redacted] [redacted]	[redacted] [redacted]
Escalation to mid-2014 dollars	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]
Total Project Costs	[redacted] [redacted]	[redacted]	[redacted]	[redacted]	$ 26M

Option C **Two New Package Boilers in Existing Zuni Building**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$23.7M

Table 4-1 Capital Cost Estimates Summary (continued)

Option D **One New Package Boiler in Existing Zuni Building**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$16.8M

Option E **Upgrade Zuni Unit 1A Boiler for Continued Reliable Operation**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]		[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$11.6M

Option F **Upgrade Zuni Unit 2 Boiler for Continued Reliable Operation**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]		[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$14.2M

Table 4-1 Capital Cost Estimates Summary (continued)

Option G **One New Package Boiler in Retired Cherokee Steam Plant**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$20M

Option H **Two or more Used Package Boilers in Existing Zuni Building**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]		[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$23.8M

Option I **Take Over Operation of Non Company-Owned Boilers and Tie into IP System**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development					[redacted]
Plant Equipment					[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]		[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$9M

Table 4-1 Capital Cost Estimates Summary (continued)

Option J **One New Package Boiler in Expanded Building at DSP**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]		[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$17.8

Option K **Tie State Boiler into IP Steam System**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development					
Plant Equipment					
Balance of Plant				[redacted]	[redacted]
EPC Indirects and Fee					
Owner indirect costs			[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars			[redacted]	[redacted]	[redacted]
Total Project Costs			[redacted]	[redacted]	$2.7M

Option L **Several Rental Boilers in Temporary Building at Zuni Site**

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development				[redacted]	[redacted]
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Balance of Plant	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee				[redacted]	[redacted]
Owner indirect costs	[redacted]		[redacted]	[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Costs	[redacted]	[redacted]	[redacted]	[redacted]	$9M

Note: Does not include rental costs for boilers, support equipment, and temporary building.

Table 4-1 Capital Cost Estimates Summary (continued)

Option Z1 — Minimum Upgrade for Short-Term Operation of Zuni 1A Boiler

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development					
Plant Equipment				[redacted]	[redacted]
Balance of Plant				[redacted]	[redacted]
EPC Indirects and Fee					
Owner indirect costs				[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars					
Total Project Costs				[redacted]	$1.9

Option Z2 — Minimum Upgrade for Short-Term Operation of Zuni 2 Boiler

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development					
Plant Equipment				[redacted]	[redacted]
Balance of Plant				[redacted]	[redacted]
EPC Indirects and Fee					
Owner indirect costs				[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars					
Total Project Costs				[redacted]	$3.0M

Option Z1+Z2 — Minimum Upgrade for Short-Term Operation of Zuni 1A and 2 Boilers

Description	Equipment Cost	Sales/Use Tax	Installation	Subcontract or Other	Total Cost
Demolition & Site Development					
Plant Equipment				[redacted]	[redacted]
Balance of Plant				[redacted]	[redacted]
EPC Indirects and Fee					
Owner indirect costs				[redacted]	[redacted]
Contingency				[redacted]	[redacted]
Escalation to mid-2014 dollars					
Total Project Costs				[redacted]	$4.2M

The level of confidence in the capital costs varies significantly among the options. For those options based on a significant level of detail and new equipment confidence level is relatively high, while for those options involving modifications to very old equipment confidence level is relatively low. Several options based on new equipment but with significant uncertainty or limited data have medium confidence level ratings.

5. O&M Cost Estimates for Options

In a similar manner, estimates for operating and maintenance labor, maintenance materials and services, and recurring annual costs were developed into incremental Operation and Maintenance (O&M) costs for each option.

These are presented in Attachment 2 to this report, and provide personnel requirements as well as other costs in a consistent format. Table 5-1 summarizes these costs for the options, and this was provided as input, along with the capital costs, for the financial ranking analysis discussed in Section 7 later in this report. Following the retirement of the Zuni Unit 2 electric generation equipment at the end of 2015, all operations continuing at the Zuni site are assumed to be carried out by the steam system and supported by steam customers.

The level of confidence in the O&M costs varies significantly among the options. For those options involving continued operation of equipment well beyond its expected lifetime confidence level is relatively low, while for options involving extensions of known situations such as DSP and State, confidence level is considered high. Estimates for options that are primarily new equipment are also considered high. Several options that depart from recent experience were evaluated to have medium confidence level ratings.

Table 5-1 Estimated O and M Costs for Options

This table summarizes detail of individual estimates (mid-2014 $1000 dollars) in Attachment 2.

Option A - Original Sun Valley Steam Center	
Incremental Head Count	12
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]
Option B - Reduced Scope Sun Valley Steam Center	
Incremental Head Count	12
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]
Option C - Two New Package Boilers in Existing Zuni Building	
Incremental Head Count	11
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]
Option D - One New Package Boilers in Existing Zuni Building	
Incremental Head Count	11
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option E - Upgrade Zuni Unit 1A Boiler for Continued Reliable Operation	
Incremental Head Count	14
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option F - Upgrade Zuni Unit 2 Boiler for Continued Reliable Operation	
Incremental Head Count	14
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option G - One New Package Boiler in Retired Cherokee Steam Plant	
Incremental Head Count	10
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option H - Two or more Used Package Boilers in Existing Zuni Building	
Incremental Head Count	$ 11
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Table 5-1 Estimated O and M Costs for Options (continued)

Option I - Take Over Operation of Non Company-Owned Boilers and Tie into IP System	
Incremental Head Count	11
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option J - One New Package Boiler in Expanded Building at DSP	
Incremental Head Count	4
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option K - Tie State Boiler into IP Steam System	
Incremental Head Count	2
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option L - Several Rental Boilers in Temporary Building at Zuni Site	
Incremental Head Count	10
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Note: Does not include rental costs for boilers, support equipment, and temporary building.

Option Z1 - Minimum Upgrade for Short-Term Operation of Zuni 1A Boiler

Incremental Head Count	14
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option Z2 - Minimum Upgrade for Short-Term Operation of Zuni 2 Boiler

Incremental Head Count	14
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

Option Z1+ Z2 - Minimum Upgrade for Short-Term Operation of Zuni 1A and 2 Boilers

Incremental Head Count	14
Incremental Direct Labor Cost	$ [redacted]
Incremental Non-Labor Costs	$ [redacted]
Total Incremental O&M Costs	$ [redacted]

6. Risks and Known Public Issues with Options

The options under consideration encompass a wide range of risks and issues that must be addressed during implementation, and may influence the selection of a preferred option. With the anticipated retirement of Zuni Station, there have not been significant capital investments. The extended operation of equipment beyond its expected physical life means that the risk of failure is higher and that we are uncertain about when and how the unit will fail.

Table 6-1 presents in summary format a reliability assessment of the various options. Those employing all or mostly new equipment and facilities are judged to be the most reliable for long-term operation, while those that rely on large, very old equipment of obsolete design and which may have hidden flaws are seen as the least reliable.

The risks increase if the total capacity of the new units does not have the same margin as the current system with both Zuni 1A and 2 boilers operable. This could expose customers to limits on supply in the event of a boiler forced outage during the peak steam demand season.

Table 6-1 Reliability Assessment of Steam Supply Options (5 = high reliability and 1 = low reliability)

Option	Description	Confidence Rating	Reason
A	Original SVSC	5	All new equipment, only concern is infant mortality with increase in reliability after year 1.
B	Reduced Scope SVSC	5	All new equipment, only concern is infant mortality with increase in reliability after year 1
C	2 New Boilers at Zuni	4	Installation of (2) new package boiler in existing building, with some continued use of very old equipment and piping.
D	1 New Boiler at Zuni	4	Installation of (1) new package boiler in existing building, with some continued use of very old equipment and piping.
E	Long-Term Zuni 1a Operation	2	Zuni 1A has seen years of operation as steam only with good success, and even with significant upgrades, old equipment may fail at any time.
F	Long-Term Zuni 2 Operation	2	Reliance on only Zuni 2 is a risk because of low load operation which has been problematic, and even with significant upgrades, old equipment may fail at any time.
G	New Boiler at Cherokee Steam	4	Installation of (1) new package boiler within historic building with limited space and poor access.
H	Used Boilers at Zuni	3	Mediocre reliability due to unknown condition of used boilers installed in old existing building with some continued use of very old equipment and piping.
I	Non Company-Owned Boilers	2	Although the appearance and history of these boilers is favorable, the age of the boilers brings their reliability into question, and the poor documentation is a risk.
J	3rd Boiler at DSP	4	New equipment is considered to be reliable. The limitations of the site for additional equipment may lead to awkward layout for equipment access.
K	State Upgrade to IP	4	Utilizing the full capacity of the State boiler supplying steam in a new line can be considered fairly reliable
L	Rental Boilers at Zuni	4	Rental equipment can be considered to be reliable, with some continued use of very old equipment and piping.
Z1	Short-Term Zuni 1a Operation	2	Zuni 1A has seen years of operation as steam only with good success, but old equipment may fail at any time.
Z2	Short-Term Zuni 2 Operation	1	Reliance on Zuni 2 is a risk because the unit will be operated at low load which has been problematic in the past.
Z1+Z2	Short-Term Zuni 1A and Zuni 2 Operation	2 to 3	The continued operation of both Zuni boilers is judged to provide better reliability than either operating by itself.

Several options have unique challenges that must be considered:

- Any option that continues to use the Zuni site will contend with the limitations of steam sendout through the steam tie-line connection to the distribution system, and continue to require maintenance of this line and its steam losses.
- Any option that is supported by the old Zuni building or some of the old Zuni equipment faces uncertain reliability and possibly high maintenance costs for its operation
- Option G faces many unknowns in the reuse of the historic Cherokee Steam Plant Building and the City consolidation of facilities personnel and shops near the main city offices and the jail. The relatively small distribution line near this facility may limit the steam sendout to a value less than assumed unless significant investment in piping replacement is made.
- For Option I, the existing facility steam operations face a series of poorly known conditions that may be expensive to overcome and maintain over time, as well as very old equipment that may have similar issues as those faced at Zuni.
- For Option J, the planned development around Union Station and the Denver Steam Plant represents a set of public relations issues that must be proactively managed for economic and successful expansion of steam supply on that site.
- For Option L, rental or used boilers represent unknown risks with evaluation of the specific equipment.
- For Options Z1 and Z2, as well as the combined Z1+Z2, recent incidents at Zuni may forewarn of decreased reliability of the old equipment, even after currently known problems are addressed.
- Continued reliable operation of the steam distribution system may significantly impact rates if a number of customers in the center of the city commit to other options.

7. Estimated Net Present Value for Each Option

Based on the costs and performance information developed in the sections above, a preliminary estimated calculation of the Net Present Value (NPV) was completed for each of the options, with the exception of Option I, which was deemed to have too many uncertainties and undefined elements to provide a reasonable basis for this calculation. This work was done by Public Service's Generation Asset Analysis and Reliability (GAAR) department, the staff normally associated with this type of analysis.

The GAAR Universal Financial Model is a proprietary excel-based tool developed by Public Service to undertake lifecycle cost financial information for generating units in order to evaluate different options or scenarios. It has been modified for similar use on Public Service 's Steam business. The options being studied for the Steam business were ranked based on capital costs, depreciation schedules, labor and non-labor O&M costs, heat rates, timing, and system/incremental capacity. Based on these variables, the net present value over 30 years was calculated for each option; discounted to the present value, and then converted to an equivalent annuity to perpetuity. It should be noted that four of the options only have a five-year lifespan, and for these, a 5-year depreciation was evaluated instead. The annuity calculation equalizes the NPVs of scenarios with different time horizons, although the 5-year options are ranked separately from the 30-year options.

Table 7-1 presents the results for each option, both as listed in the report (A through Z1+Z2) and by rank order for NPV for each option lifetime. Option I was not evaluated because it was judged that the lack of information about costs and performance was too significant at this time. A number of assumptions made to complete the analysis are also detailed as notes to the table. The capital, O&M and fuel components of the total NPV values are also presented so that the cost drivers are more visible for each option. The NPV divided by the added capacity for each option is also calculated, and a separate ranking for the 5-year and 30-year options is also provided for NPV($)/kpph.

Table 7-1
Summary Comparison of Key Option Characteristics

Category	A	B	C	D	E	F	G	H	I	J	K	L	Z1	Z2	Z1 + Z2
	30 Year Options											5 Year Options			
Total Project Capital Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Subtotal of Project Direct Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Percent of Total Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EPC Indirects and Fee Allow	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Percent of Direct Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Indirect Cost Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Percent of Total Direct Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Contingency included	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Percent of Total Direct Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Capital Costs (2011 $)	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
(2013$)		[redacted]													
Escalation Added for 2014 $	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Percent of Direct and Indirects	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Incremental O&M Labor Annual Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Incremental O&M non-Labor Annual Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Project Incremental Annual O&M Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Capital Estimate Confidence Factor	High	High	Medium	Medium	Low	Low	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium
O&M Estimate Confidence Factor	High	High	Medium	Medium	Low	Low	High	Medium	Low	High	High	Medium	Medium	Medium	Medium
Steam Supply Reliability Factor	5	5	4	4	2	2	4	3	2	4	4	4	2	1	2 to 3
Steam Supply Capacity (kpph)															
Existing Operational Supply Capacity	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340
Existing Maximum Supply Capacity	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390
Added Winter Capacity for Option	280	280	280	160	280	280	130	280	80	160	40	260	280	280	280
Winter Operating Capacity with Option	620	620	620	500	620	620	470	620	420	500	380	600	620	620	620
Total Winter Capacity with Largest Out	340	340	340	320	340	340	290	340	240	320	200	420	340	340	340
Total Winter Capacity with DSP2 Out	440	440	440	320	440	440	290	440	240	320	200	420	440	440	440
Capital Cost/Added Flow (k$/kpph)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Incremental O&M Cost/Added Flow (k$/kpph)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Revenue Requirements (NPV,$M) 5-Year												[redacted]	[redacted]	[redacted]	[redacted]
Revenue Requirements (NPV,$M) 30-Year	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted] 9				
PVRR/Added Capacity ($/kpph) 5-Year												[redacted]	[redacted]	[redacted]	[redacted]
PVRR/Added Capacity ($/kpph) 30-Year	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]				

Options

A	Original Sun Valley Steam Center
B	Reduced Scope Sun Valley Steam Center
C	Two New Packaged Boilers Zuni Turbine Deck
D	One New Packaged Boiler ZuniTurbine
E	Continue Operation of Zuni Unit 1A Boiler > 10 years
F	Continue Operation of Zuni Unit 2> 10 years
G	One New Packaged Boiler at CoD Cherokee Station
H	Two or more Used Package Boilers Zuni Turbine Deck
I	Lease (Other - Distributed Generation) Boilers & tie into IP steam system
J	One New Packaged Boiler at Denver Steam Plant
K	Tie State Boiler into IP Steam System
L	Rental Boilers in a Temp Bldg on Zuni Site
Z1	Minimum Investment for < 5 year Operation of Zuni 1A Boiler Minimum
Z2	Investment for < 5 year Operation of Zuni 2 Boiler Minimum Investment for < 5
Z1+Z2	year Operation of Zuni 1A and 2 Boilers

8. Conclusion

This report has presented a significant amount of information about the available options for development of the supply-side options for the steam system to supplement the baseline capability of Denver Steam Plant and the State Steam Plant. A remaining major unknown is how the changes in steam rates will impact existing customer decisions about continuing to buy steam, or create opportunities for new customers to join the steam system. The interaction of capital costs, O&M and fuel costs, and accounting rules have been considered for each of the options presented here in order to rank the options based on financial requirements. This financial analysis contributes to the decision on the preferred strategy going forward as the future demand is better understood.

The evaluation of the options is based on the calculated NPV, tempered by some of the other factors that represent risks and opportunities that are not obvious from the raw numbers. There are several leading candidates, which offer different value propositions, and a number of options that are much less likely to be implemented given the information available at this time. The preferred candidates have been identified, but the limitations of all of the options in general are the following:

- Option K, the interconnection of the State boiler to the IP steam system, is a low-capital-cost way to boost the system capacity by 40,000 pph, and it also allows increased system reliability and operational flexibility because the State Steam Plant Boiler could then cover the summer system demand while DSP undergoes its annual maintenance outage. It is also advantageous because the SSP boiler is the newest one in the system, and increases operating time for the SSP boiler while improve overall system efficiency, while also reducing Zuni's operating hours. This should lower O&M expenses and help to some degree to mitigate the risk of a Zuni failure. However, this option alone would not be sufficient to meet the future system requirements if the production demand was at a similar level to what we observe today.

- A limited investment approach, Option Z1 + Z2, keeping both Zuni 1A and 2 boilers available for the next five years also appears to be a low-cost approach to maintaining the status quo (280,000 pph above baseline of DSP and State), while Public Service assesses future demand on the system. Unit 1A has provided consistent and fairly reliable service in steam-only operation since before its turbine generator was retired; that said, continued operation has a significant possibility of equipment failure, even though the assessment has not identified any specific problems beyond those recommended as Option Z1. The reliability issue going forward is a strong argument for keeping Unit 2 boiler operational as a backup, in case Unit 1A has a forced outage during the winter peak. However, Unit 2 operating by itself at Zuni would limit the system operational flexibility due to its untested ability to operate reliably at very low percentage of its design load. Also, the continued use of Zuni represents a high O&M and fuel cost for each hour of operation compared to the more efficient plants on the system.

- The next lowest cost options are those that add one new package boiler to the system, and would be best approach if the new steam demand can be met with that much added capacity for the long term future. Among Options D (one new boiler at Zuni), G (one boiler at Cherokee Steam), and J (third boiler at DSP), the latter is judged to offer the highest probability of long-term reliable and efficient operation. It would allow the complete retirement of Zuni Station, which the City of Denver desires for redevelopment near downtown, a consolidation of O&M resources into one crew (which also operates the SSP boiler), and the two connections to the steam distribution system at DSP will allow operational flexibility. It would also allow the retirement of the steam lines from Zuni plant to the main part of the distribution system, which would save maintenance costs and increase distribution efficiency.

The addition of a boiler at Zuni (Option D) is possible, but the old building and connection to old equipment at key points is evaluated to have higher maintenance costs, and it would not allow retirement and redevelopment of the site, or retirement of the steam connection to downtown Denver. One possible unevaluated advantage to maintaining the Zuni steam tie line would be to supply steam to the new Sun Valley development. But continued use of Zuni for support of the steam supply system would significantly increase O&M head count for the business.

- The assessment of adding a boiler at the historic Cherokee Steam Plant building (Option G) has a high uncertainty at this preliminary level. Removing the equipment and asbestos from the existing building, and installing new equipment with the small site and limited wall openings is expected to be difficult and expensive, and was judged to limit the boiler capacity that could be installed. The steam distribution near this site is currently limited to a 10" diameter line. Further, the willingness of the City of Denver to vacate this building, which is in the middle of their facilities area that supports their nearby downtown buildings, and the cost to purchase or lease this building have not been determined.

- Most of the other options present a higher-cost profile, and could only be justified with a long-term demand similar to the recent peak values. Options A (SVSC), B (reduced scope SVSC), C (two new boilers at Zuni), and H (adding used boilers at Zuni), would maintain the system capacity at its current level, and would be expected to be a reliable, low total cost over the thirty year planning horizon. There is probably insufficient space at DSP to add a fourth boiler, unless a multi-story approach was applied, so that possibility was not included.

- Option I was eliminated before the revenue requirements were calculated because of the significant unknowns remaining after this brief evaluation. With existing boilers almost as old as the Zuni units, and very little information or files available for the equipment, and no negotiations completed about the lease cost and steam sales from the system, it was judged that too many variables were not clearly defined and a net present value could not be calculated with any reasonable level of confidence. As a long-term option, it is expected that the existing boilers would need to be replaced, and completing this changeout in the basement of an operating hotel, while maintaining 24/7 operational profile, especially when it would involve removing structural walls, would be a daunting challenge.

- Option L (Rental boilers at Zuni) was assessed as a short-term strategy to minimize the potential of long-term capital investment in steam facilities. The resulting treatment of all costs as O&M, however, results in a very expensive option for the value delivered.

9. Recommendations

Based on this evaluation, which has attempted to place the options on comparable levels given the available data, the following strategy is recommended as a path forward during the transition of the steam business toward its long-term production capacity determination. This recommendation requires both Managerial and Regulatory approvals before significant expenditures are undertaken.

1) Public Service should implement the short-term minimum investments in Option Z1+Z2 to allow the system to meet steam demand for up to the next three to five years. This is feasible based on the assessment work done during 2014, but retains a residual risk of an unknown major failure on either Unit 1A or 2 (and maybe both as a worst case). Note that there are cost savings associated with implementing both Option Z1 and Option Z2 together, but no additional capacity from both due to the limitation in the steam tie line connection.

2) Public Service should implement Option K to tie the State boiler to the IP distribution system to gain the improved system reliability and operational flexibility, regardless of other options that may be chosen. This makes sense both as a short-term and long-term partial solution. It will allow the newer boiler at SSP to carry the system load during the DSP summer outage, as well as operate more hours per year, which will partially mitigate the risk and costs associated with running the older equipment at Zuni.

3) Recognizing that development of a new boiler on the system will take several years, and that the Zuni short-term solution set forth in #1 above is only expected to be effective during the next 3-5 years, Public Service should proactively work to conceptually develop Option J, the addition of a new boiler to the DSP plant. There are political issues with the pace of new high rise development in the area, and the limited space available on the site. Air modeling work should begin immediately, to determine what is necessary for the new stack, and a conceptual layout of the site with the new boiler and its support equipment should be prepared, as well as a corresponding cost estimate and schedule. The existing buried #6 oil tank should be demolished and removed. The impact of changing the exterior of the buildings on the site to complement neighboring buildings should also be evaluated. Preliminary discussions with the City may be necessary for a deal to vacate Zuni but retain expanded capability at DSP.

4) If the demand stays near current levels into the extended future, we recommend Option B (reduced scope SVSC) Reliability issues with the existing equipment and buildings recommend against implementing any long-term Zuni options, including C (two new boilers at Zuni), D (one new boiler at Zuni), E (life extension of Zuni 1A), F (life extension of Zuni 2), or H (used boilers at Zuni).

Attachment 1 – Detailed Capital Cost Estimate Information

Attachment 2 – Detailed O&M Head Count and Cost Estimate Information

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Xcel Energy
Denver Steam Heat System
Original Sun Valley Steam Center
Project Capital Cost Estimate
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Option A

Project Description/Scope Definition:	Equipment/Material		Labor		SVSC original	Adjusted			
Description	Equipment Cost	Sales/Use Tax 7.62%	Install Cost	Sub-Contracts	Total Cost	Total Cost	Note	Comment	
Demoltion				[redacted]	[redacted]	[redacted]	Added by Xcel (allowance)		
Site Development				[redacted]	[redacted]	[redacted]	same as B&M		
Concrete	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Masonry				[redacted]	[redacted]	[redacted]	same as B&M		
Structural Steel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Roofing & Siding	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Doors & Windows	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Architectural Finishes	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel increased equipment cost (+32%) and added tax to B&M	Increase not spread to individual line items	
Office Space				[redacted]	[redacted]	[redacted]	Added by Xcel (allowance)		
Furnishings	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Conveying	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Electrical	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Xcel added tax to B&M		
Electrical Interconnect, cost of second service				[redacted]	[redacted]	[redacted]	Added by Xcel (allowance)		
Gas Service Upgrade				[redacted]	[redacted]	[redacted]	Added by Xcel (allowance)		
Steam Interconnection				[redacted]	[redacted]	[redacted]	Added by Xcel (allowance) Eliminated redundant cost		
Subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			
Engineering -Detail Design				[redacted]	[redacted]	[redacted]	same as B&M, 40% of subtotal below		
Construction Management/GC's				[redacted]	[redacted]	[redacted]	same as B&M, 37% of subtotal below		
Design Build Fee				[redacted]	[redacted]	[redacted]	same as B&M, 23% of subtotal below		
Subtotal - EPC Indirects and Fee	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	15% of Direct Costs Subtotal above (revised contracting approach to match modified SVSC estimate)		
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Small rounding error due to percentages above		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]	[redacted]	Added by Xcel		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]	[redacted]	Added by Xcel		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]	[redacted]	Added by Xcel		10.5%
E&C Engineering			$[redacted]		$[redacted]	[redacted]	Added by Xcel (Reduced to match revised contracting approach for modified SVSC)		3.0%
E&C Technical Services			[redacted]		[redacted]	[redacted]	Added by Xcel (Reduced to match revised contracting approach for modified SVSC)		
Construction Management Services			[redacted]		[redacted]	[redacted]	Added by Xcel	Reduced and included more of this scope in CM Fee above	17.5%
Startup & Testing Services			$[redacted]		$[redacted]	$[redacted]	Added by Xcel		7.5%
Professional Services			$[redacted]		$[redacted]	$[redacted]	Added by Xcel		5.0%
Other Indirect Costs	$[redacted]			$[redacted]	$[redacted]	$[redacted]	Added by Xcel	Slight reduction due to reduction in project costs	16.0%
					[redacted]				
[redacted]				[redacted]	[redacted]	$[redacted]	Added by Xcel	Reduced due to EPC role to purchase equipment above	7.0%
A&G - (Pwr Plant Overheads)				$[redacted]	$[redacted]	$[redacted]	Added by Xcel	Slight reduction due to reduction in project costs	14.0%
Subtotal of indirects above	$[redacted]	[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	4.4% of EPC directs above, due to revised contracting approach assumed		100%
Escalation over Life of Project				$[redacted]	[redacted]	[redacted]			
Contingency on total project				$[redacted]	[redacted]	$[redacted]	Reduced from B&M 15% or $3.25m	3% of Direct Costs for consistency with other estimates	
TOTAL INDIRECT COSTS	$[redacted]	[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]			
TOTAL PROJECT COSTS (2011 Dollars)	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]			
Escalate pricing from 2011 to 2014	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts		
TOTAL PROJECT COSTS	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$29M			

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Xcel Energy
Denver Steam Heat System
Modified Sun Valley Steam Center
Project Capital Cost Estimate
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Option B

Project Description/Scope Definition: Description	Equipment/Material: Equipment Cost	Equipment/Material: Sales/Use Tax 7.62%	Labor: Install Cost	Labor: Sub-Contracts	Original SVSC Total Cost	XCEL modified SVSC Total Cost	Adjusted Estimate: Revised Totals	Note	Comment	
Demoltion				[redacted]	[redacted]	[redacted]	[redacted]		Added by Xcel (allowance)	
Site Development				[redacted]	[redacted]	[redacted]	[redacted]		same as B&M	
Concrete	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduce Building Size from 20,200 to 10,800 sf	Xcel added tax to B&M	
Masonry				[redacted]	[redacted]	[redacted]	[redacted]	Reduce Building Size from 20,200 to 10,800 sf	same as B&M	
Structural Steel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduce Building Size from 20,200 to 10,800 sf	Xcel added tax to B&M	
Roofing & Siding	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduce Building Size from 20,200 to 10,800 sf	Xcel added tax to B&M	
Doors & Windows	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduce Building Size from 20,200 to 10,800 sf	Xcel added tax to B&M	
Architectural Finishes	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduce Building Size from 20,200 to 10,800 sf	Xcel added tax to B&M	
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		Xcel increased equipment cost (+32%) and added tax to B&M	
Office Space				[redacted]	[redacted]	[redacted]	[redacted]	Removed Office Space	Added by Xcel (allowance)	
Furnishings	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduction due to reduction in building space	Xcel added tax to B&M	
Instruments	$[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		Xcel added tax to B&M	
Conveying	[redacted]	[redacted]	[redacted]	[redacted]	$[redacted]	[redacted]	[redacted]		Xcel added tax to B&M	
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	$[redacted]	[redacted]	$[redacted]		Xcel added tax to B&M	
Electrical	[redacted]	[redacted]	[redacted]	[redacted]	$[redacted]	[redacted]	$[redacted]		Xcel added tax to B&M	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	$[redacted]	[redacted]	$[redacted]		Xcel added tax to B&M	
Electrical Interconnect, cost of second service				[redacted]	$[redacted]	[redacted]	$[redacted]		Added by Xcel (allowance)	
Gas Service Upgrade				[redacted]	$[redacted]	[redacted]	$[redacted]		Added by Xcel (allowance)	
Steam Interconnection				[redacted]	[redacted]	[redacted]	[redacted]	Eliminate Redundant Steam Interconnection was included by B&M in original but is not required.		
Subtotal of above	$[redacted]	$[redacted]	$[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			5.64%
Engineering -Detail Design				[redacted]	[redacted]	[redacted]	[redacted]	40% of subtotal below		0.402085577
Construction Management/GC's				[redacted]	[redacted]	[redacted]	[redacted]	Added equipment procurement & more Engineering During Construction (EDC's) to cover less E&C involvement - 37% of subtotal below		0.368151237
Design Build Fee				[redacted]	[redacted]	[redacted]	[redacted]	23% of subtotal below		0.229763187
Subtotal - EPC Indirects and Fee	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	13.5% of Direct Subtotal above		
TOTAL INSTALLATION DIRECT COSTS	$[redacted]	$[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduction from Xcel modified SVSC	Xcel added $4.2m to B&M total	
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]	[redacted]	[redacted]		9.0%	
Client Department (Plant Staff)			[redacted]		[redacted]	[redacted]	[redacted]		10.5%	
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]	[redacted]	[redacted]		10.5%	
E&C Engineering			[redacted]		[redacted]	[redacted]	[redacted]	Reduced and moved to direct EPC costs above	3.0%	
E&C Technical Services			[redacted]		[redacted]	[redacted]	[redacted]	Reduced and moved to direct EPC costs above		
Construction Management Services			[redacted]		[redacted]	[redacted]	[redacted]	Reduced and included more of this scope in CM Fee above	17.5%	
Startup & Testing Services			[redacted]		[redacted]	[redacted]	[redacted]		7.5%	
Professional Services			[redacted]		[redacted]	[redacted]	[redacted]		5.0%	
Other Indirect Costs	[redacted]			[redacted]	[redacted]	[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%	
Purchase Load (Sourcing)				[redacted]	[redacted]	$[redacted]	[redacted]	Reduced due to EPC role to purchase equipment above	7.0%	
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%	
Subtotal in Indirects above	[redacted]	[redacted]	[redacted]	[redacted]	$[redacted]	[redacted]	[redacted]	3% of EPC directs (compared to 8.3% for original SVSC)	above % distribution related to this subtotal for adjusted estimate	
Escalation over Life of Project					[redacted]	[redacted]	[redacted]			
Contingency on total project				$[redacted]	$[redacted]	[redacted]	[redacted]	Remove Owners Contingency	3% of Direct Costs without Fixed Price Bid recommended, but not included due to previous Xcel commitment	
TOTAL INDIRECT COSTS	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	[redacted]	[redacted]			
TOTAL PROJECT COSTS (2013 $)	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	[redacted]	[redacted]	Estimate revised by Xcel in 2nd Qtr 2013		
Escalate Pricing from 2013 to 2014						[redacted]	[redacted]	3.5% of materials, 5.5% of labor, 3% of subcontracts		
TOTAL PROJECT COSTS	$[redacted]	$[redacted]	$[redacted]	$[redacted]	$[redacted]	[redacted]	$26M			

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

##

Xcel Energy
Denver Steam Heat System
Two New Packaged Boilers inside Zuni Building
Project Capital Cost Estimate
-CONFIDENTIAL-

Option C

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]	Site development reduced from SVSC	
Concrete	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Concrete Reduced from SVSC	
Masonry				[redacted]	[redacted]	Masonry Eliminated except repairs	Wall repairs added, and access for equipment installation
Structural Steel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Steel Reduced from SVSC	1/2 Mezzanine Steel maintained
Roofing & Siding				[redacted]	[redacted]	Roofing and siding eliminated except repairs	Complete RO roof replacement
Doors & Windows				[redacted]	[redacted]	Doors and Windows eliminated except noted at right	New rollup doors for equipment installation
Architectural Finishes				[redacted]	[redacted]	Finishes Eliminated except noted at right	Bare equipment painting
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC except reuse condensate tanks, air compressors	
Office Space		[redacted]			[redacted]	Office Eliminated	Use existing office space
Furnishings	[redacted]	[redacted]			[redacted]	Furnishings eliminated except noted at right	Upgrade shop equipmen and furniture
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Conveying	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 80%	
Electrical	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Electrical Interconnect, cost of new service				[redacted]	[redacted]	Assume replacement of demolished equipment	
Gas Service Upgrade		[redacted]			[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]	Ugrade needed	
City Sewer Interconnection				[redacted]	[redacted]	Ugrade needed	
Subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of of subtotal below	
Subtotal - EPC Indirects and Fee				[redacted]	[redacted]	15% of Direct Subtotal above	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%
					[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Subtotal of indirects above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	5% of direct costs above	above % distribution related to this subtotal for adjusted estimate
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	3% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	$[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	**$23,7M**		

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

Xcel Energy
Denver Steam Heat System
One New Packaged Boiler within Zuni Building
Project Capital Cost Estimate
-CONFIDENTIAL-

Option D

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]	Site development reduced from SVSC	
Concrete	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Concrete Reduced from SVSC	
Masonry	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Masonry Eliminated except repairs	Wall repairs added, and access for equipment installation
Structural Steel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Steel Reduced from SVSC	1/2 Mezzanine Steel maintained
Roofing & Siding				[redacted]	[redacted]	Complete RO roof replacement	
Doors & Windows				[redacted]	[redacted]	New rollup door for equipment installation	
Architectural Finishes				[redacted]	[redacted]	Finishes Eliminated except at right	Bare equipment painting
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 65%, reuse condensate tanks, air compressors	
Office Space		[redacted]			[redacted]	Office Eliminated	Use existing office space
Furnishings	[redacted]	[redacted]			[redacted]	Furnishings eliminated except at right	Upgrade shop equipmen and furniture
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 65%	
Conveying	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 65%	
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 65%	
Electrical	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 65%	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 75%	
Electrical Interconnect, cost of new service				[redacted]	[redacted]	Assume replacement of demolished equipment	
Gas Service Upgrade		[redacted]			[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]	Ugrade needed	
City Sewer Interconnection				[redacted]	[redacted]	Ugrade needed	
Subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC indirects and fee				[redacted]	[redacted]	15% of Subtotal above	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		$[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	$[redacted]	Slight reduction due to reduction in project costs	16.0%
					$[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Subtotal of Indirects above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	5% of direct costs above	above % distribution related to this subtot
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	4% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	$[redacted]	[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	$16,8M		

CONFIDENTIAL INFORMATION
HAS BEEN REDACTED

##

Xcel Energy
Denver Steam Heat System
Zuni Unit 1A Boiler and system upgrades
Project Capital Cost Estimate
-CONFIDENTIAL-

Option E

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]		
Concrete				[redacted]	[redacted]		
Masonry				[redacted]	[redacted]	Masonry Eliminated except repairs	Wall repairs added, and access for equipment installation
Structural Steel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		1/4 SVSC Mezzanine Steel maintained
Roofing & Siding				[redacted]	[redacted]	Complete RO roof replacement	
Doors & Windows				[redacted]	[redacted]	Eliminated	
Architectural Finishes				[redacted]	[redacted]		Bare equipment painting
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	only FO and water treatment equipment	
Office Space		[redacted]			[redacted]		Use existing office space
Furnishings	[redacted]	[redacted]			[redacted]		Upgrade shop equipment and furniture
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	upgrade some components as needed	20% of SVEC
Conveying				[redacted]	[redacted]		
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	upgrade some components as needed	20% of SVEC
Electrical				[redacted]	[redacted]	see allowance below	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVEC x 50%	
Electrical Interconnect, cost of new service				[redacted]	[redacted]	Assume replacement of demolished equipment	
Gas Service Upgrade		[redacted]			[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]	Ugrade needed	
City Sewer Interconnection				[redacted]	[redacted]	Ugrade needed	
subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Unit 1A upgrades							
Replace BFPs				[redacted]	[redacted]		
Replace fuel oil system, burners and BMS				[redacted]	[redacted]	includes allowance for asbestos abatement for BMS	Switch to #2 oil
Replace switchgear, transformers, MCCs, cabling				[redacted]	[redacted]	High priority items only, + allowance for cabling	
Replace Boiler Control System and other controls				[redacted]	[redacted]		
Structural repair of stack				[redacted]	[redacted]		shorten stack
Structural improvement for new equipment				[redacted]	[redacted]		
Add CEMS for Boiler 1A				[redacted]	[redacted]		
Unit 1A upgrade subtotal				[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC indirects and fee				[redacted]	[redacted]	15% of subtotals above	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%
					[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Indirect Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6% of direct costs above	above % distribution related to this subtotal for adjusted estimate
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	5% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	$11.6M		

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

##

Xcel Energy
Denver Steam Heat System
Zuni Unit 2 Boiler and system upgrades
Project Capital Cost Estimate
-CONFIDENTIAL-

Option F

Project Description/Scope Definition:	Equipment/Material		Labor		Total Cost	Note	Comment
Description	Equipment Cost	Sales/Use Tax 7.62%	Install Cost	Sub-Contracts	Total Cost	Note	Comment
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]		
Concrete				[redacted]	[redacted]		
Masonry				[redacted]	[redacted]	Masonry Eliminated except repairs	Wall repairs added, and access for equipment installation
Structural Steel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		1/4 SVSC Mezzanine Steel maintained
Roofing & Siding				[redacted]	[redacted]	Complete RO roof replacement	
Doors & Windows				[redacted]	[redacted]		
Architectural Finishes				[redacted]	[redacted]		Bare equipment painting
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	only FO and water treatment equipment	
Office Space		[redacted]			[redacted]		Use existing office space
Furnishings	[redacted]	[redacted]			[redacted]		Upgrade shop equipmen and furniture
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	upgrade some components as needed	20% of SVEC
Conveying				[redacted]	[redacted]	eliminated	
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	upgrade some components as needed	20% of SVEC
Electrical				[redacted]	[redacted]	see allowance below	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVEC x 75%	
Electrical Interconnect, cost of second service				[redacted]	[redacted]		
Gas Service Upgrade		[redacted]			[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]	Ugrade needed	
City Sewer Interconnection				[redacted]	[redacted]	Ugrade needed	
subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Unit 2 upgrades							
Boiler superheater mods for low load operation				[redacted]	[redacted]		Very high risk without this
Replace Boiler Control System and other controls				[redacted]	[redacted]		
Replace BFPs				[redacted]	[redacted]		Replace all pumps?
Replace burners and BMS				[redacted]	[redacted]	includes allowance for asbestos abatement for BMS	Switch to #2 oil
Replace switchgear, transformers, MCCs, cabling				[redacted]	[redacted]	High priority items only with allowance for cabling	
Add CEMS for Boiler 2				[redacted]	[redacted]		
Unit 2 subtotal				[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee		[redacted]		[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC indirects and fee				[redacted]	[redacted]	15% of subtotals above	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%
					[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Indirect Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6% of facility upgrades above	above % distribution related to this subtotal for adjusted estimate
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	5% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	$14,.2M		

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

Xcel Energy
Packaged Boiler in City's Retired Cherokee Steam Plant
Single Package Boiler (150,000 #/hr)
Project Capital Cost Estimate
-CONFIDENTIAL-

Option G

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Notes**	
Demolition Includes Asbestos Abatement				[redacted]	[redacted]	Allowance from Xcel	Value assumed without analysis
Site Development				[redacted]	[redacted]	Allowance from Xcel small footprint	Value assumed without analysis
Concrete	[redacted]	[redacted]	[redacted]		[redacted]	Allowance from Xcel	Value assumed without analysis
Masonry				[redacted]	[redacted]	Allowance from Xcel, brick exterior and stack	Value assumed without analysis
Structural Steel	[redacted]	[redacted]	[redacted]		[redacted]	Allowance from Xcel	Value assumed without analysis
Roofing	[redacted]	[redacted]		[redacted]	[redacted]	Allowance from Xcel	Value assumed without analysis
Doors & Windows	[redacted]	[redacted]	[redacted]		[redacted]	Allowance from Xcel, massive old windows	Value assumed without analysis
Architectural Finishes	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Allowance from Xcel	Value assumed without analysis
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	1/2 equipment, 1/2 labor as SVSC,	assume tanks outside
Control Room				[redacted]	[redacted]	Allowance from Xcel	Value assumed without analysis
Furnishings	[redacted]	[redacted]	[redacted]		[redacted]	27% equipment, same labor as SVSC	
Instruments	[redacted]	[redacted]	[redacted]		[redacted]	Allowance from Xcel	
Conveying						None included	
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	1/2 equipment, same labor as SVSC,	Value assumed without analysis
Electrical	[redacted]	[redacted]	[redacted]		[redacted]	1/2 equipment, same labor as SVSC	Value assumed without analysis
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	1/2 of SVSC,	Value assumed without analysis
Electrical Interconnect, cost of second service				[redacted]	[redacted]	Allowance from Xcel 125% of SVSC	Value assumed without analysis
Gas Service Upgrade				[redacted]	[redacted]	Allowance from Xcel	Value assumed without analysis
Steam Interconnection				[redacted]	[redacted]	Allowance from Xcel	Value assumed without analysis
Water and Sewer Interconnection				[redacted]	[redacted]	Needs better definition	Value assumed without analysis
Property Acquisition -				[redacted]	[redacted]	The cost has not been determined	Value assumed without analysis
						Building footprint about 55' x 90' rectangle, lot maybe 150'x100'	
Subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC Indirects and Fee				[redacted]	[redacted]	18% of Subtotal above	Higher than other estimates
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]		3.0%
E&C Technical Services							
Construction Management Services			[redacted]		[redacted]		17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]		16.0%
Purchase Load (Sourcing)				[redacted]	[redacted]		7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]		14.0%
Subtotal of Indirects above	[redacted]		[redacted]	[redacted]	[redacted]	8% of direct costs above	above % distribution related to this subtotal for adjusted estimate
Escalation over Life of Project							
Contingency on total project				[redacted]	[redacted]	10% of Direct Cost	Higher than other estimates due to uncertainty
TOTAL INDIRECT COSTS	[redacted]		[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	**$20.0M**		

This estimate was developed by PSCo Engineering and Construction Department with support from Burns and McDonnell.

##

Xcel Energy
Denver Steam Heat System
Two Used Package Boilers within Zuni Building
Project Capital Cost Estimate
-CONFIDENTIAL-

Option H

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	Equipment Cost	Sales/Use Tax 7.62%	Install Cost	Sub-Contracts	Total Cost	Note	Comment
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]	Site development reduced from SVSC	
Concrete	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Concrete Reduced from SVSC	
Masonry				[redacted]	[redacted]	Masonry Eliminated except repairs	Wall repairs added, and access for equipment installation
Structural Steel	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Steel Reduced from SVSC	1/2 Mezzanine Steel maintained
Roofing & Siding				[redacted]	[redacted]	Roofing and siding eliminated except at right	Complete RO roof replacement
Doors & Windows				[redacted]	[redacted]	Doors and Windows eliminated except at right	New rollup doors for equipment installation
Architectural Finishes				[redacted]	[redacted]	Finishes Eliminated except at right	Bare equipment painting
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Adjust SVEC for used boilers (-20%)	Reuse condensate tanks & air comp.
Office Space		[redacted]			[redacted]	Office Eliminated	Use existing office space
Furnishings	[redacted]	[redacted]			[redacted]	Furnishings eliminated except at right	Upgrade shop equipmen and furniture
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Conveying	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 80%	
Electrical	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	same as SVSC	
Electrical Interconnect, cost of second service				[redacted]	[redacted]		
Gas Service Upgrade		[redacted]			[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]	Ugrade needed	
City Sewer Interconnection				[redacted]	[redacted]	Ugrade needed	
Boiler Transportation Cost				[redacted]	[redacted]	Quote needed	Value assumed without analysis
Boiler Inspection and Repair Allowance				[redacted]	[redacted]		Value assumed without analysis
Subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC Indirects and Fee				[redacted]	[redacted]	16% of subtotal above	Somewhat higher than other estimates
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%
					[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Subtotal of indirects above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	5.5% of direct costs above	above % distribution related to this subtotal for adjusted estimate
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	4% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	$23.8M		

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

##

Xcel Energy
Denver Steam Heat System
Lease and Operate Non Company Owned
Facility on IP system Project Capital Cost
Estimate
-CONFIDENTIAL-

Option I

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Demoltion				[redacted]	[redacted]		
Site Development				[redacted]	[redacted]		
Concrete				[redacted]	[redacted]		
Masonry				[redacted]	[redacted]		
Structural Steel				[redacted]	[redacted]		
Roofing & Siding				[redacted]	[redacted]		
Doors & Windows				[redacted]	[redacted]	Allowance for separate entry, security, etc.	
Architectural Finishes				[redacted]	[redacted]	New Control Room.	
Plant Equipment				[redacted]	[redacted]		
Office Space				[redacted]	[redacted]		Use control room space
Furnishings	[redacted]	[redacted]			[redacted]	Allowance	
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	upgrade components	15% of SVSC
Conveying				[redacted]	[redacted]		
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	upgrade components see allowance	15% of SVSC
Electrical				[redacted]	[redacted]	below	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 75%	
Electrical Interconnect, cost of second service				[redacted]	[redacted]	Allowance	Value assumed without analysis
Gas Service Upgrade		[redacted]			[redacted]	Gas service Existing	Assume compressors used if needed
Steam Interconnection				[redacted]	[redacted]	Connect to IP system Allowance for	Xcel Steam estimate
City Water Interconnection				[redacted]	[redacted]	Upgrade Assumed adequate for steam	Value assumed without analysis
City Sewer Interconnection				[redacted]	[redacted]	operations	Value assumed without analysis
subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Upgrades							
New Boiler System Controls				[redacted]	[redacted]		Value assumed without analysis
Add redundant BFPs, etc				[redacted]	[redacted]		Value assumed without analysis
Expand water treatment capacity				[redacted]	[redacted]		Value assumed without analysis
Replace some electrical equipment				[redacted]	[redacted]	Selective equipment upgrades as needed	Cabling also included?
Repair refractory, Boiler 2				[redacted]	[redacted]	Guestimate, Need Quote from outside	Value assumed without analysis
Investigate permit for all boiler operation				[redacted]	[redacted]	entity	Value assumed without analysis
Add CEMS to stack				[redacted]	[redacted]	Not sure if needed	Value assumed without analysis
Subtotal				[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC indirects and fee				[redacted]	[redacted]	15% of subtotal above	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%
					[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Indirect Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	15% of EPC directs above	above % distribution related to this subtotal for adjusted estimate
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget and allowance pricing	5% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Reduced because not heavily based on SVSC estimate	1% of previous line
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	$9M		

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

##

Xcel Energy
Denver Steam Heat System
One Packaged Boiler within expanded DSP Building
Project Capital Cost Estimate
-CONFIDENTIAL-

Option J

revised 9/24/14

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Demoltion				[redacted]	[redacted]	Minimal assumed	
Site Development				[redacted]	[redacted]	Site development west of current building?	Value assumed without analysis
Concrete	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Concrete for extended DSP building	1/4 SVSC Concrete
Masonry				[redacted]	[redacted]	Allowance for switchgear room	Value assumed without analysis
Structural Steel	[redacted]	[redacted]	[redacted]		[redacted]	Steel for extended DSP building	1/4 SVSC Steel maintained
Roofing & Siding	[redacted]		[redacted]	[redacted]	[redacted]	Building roof and siding	1/4 SVSC Roof & siding
Doors & Windows	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	New items for DSP expansion	Factored from SVSC for specific items
Architectural Finishes				[redacted]	[redacted]	Finishes for DSP expansion	Bare equipment painting from SVSC
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 60%	
Office Space		[redacted]			[redacted]		Use existing office space
Furnishings		[redacted]			[redacted]		
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 60%	
Conveying	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 60%	
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 60%	
Electrical	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 60%	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVSC x 60%	
Electrical Interconnect, cost of second service				[redacted]	[redacted]		Value assumed without analysis
Extra Air Modeling and Permit support				[redacted]	[redacted]		Value assumed without analysis
Gas Service Upgrade				[redacted]	[redacted]	Gas service Existing (Upgrade?)	Value assumed without analysis
Steam Interconnection				[redacted]	[redacted]	Steam Connection existing, upgrade safety valve capacity	Value assumed without analysis
Removal of underground fuel storage				[redacted]	[redacted]	Soil contamination is assumed to be negligilble, current monitoring of soil shows no contamination.	
Water Treatment Equipment				[redacted]	[redacted]	Added capacity for new boiler	
City Sewer Interconnection				[redacted]	[redacted]	Upgrade needed for DSP?	Value assumed without analysis
Subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC indirects and fee				[redacted]	[redacted]	15% of subtotal above	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%
					[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Subtotal of indirects above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6% of direct costs above	above % distribution related to this subtotal for adjusted estimate
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	4.5% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	**$17.8M**		

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

Xcel Energy
Connect State Boiler Plant to IP Steam System
Upgrade Interconnection Only
Project Capital Cost Estimate
-CONFIDENTIAL-

Option K

revised 9/24/14

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	Equipment Cost	Sales/Use Tax 7.62%	Install Cost	Sub-Contracts	Total Cost	Notes	
Demolition Includes Asbestos Abatement							
Site Development							
Concrete							
Masonry							
Structural Steel							
Roofing							
Doors & Windows							
Architectural Finishes							
Plant Equipment							
Control Room							
Furnishings							
Instruments							
Conveying							
Piping & Building Systems							
Electrical							
Start-up							
Electrical Interconnect, cost of second service						Assumed not needed	
Gas Service Upgrade						Gas service Existing	Based on firm gas only
Steam Interconnection				[redacted]	[redacted]	LP Steam Connection existing	Upgrade estimated by Steam group
Water and Sewer Interconnection							
Air Modeling and Permit support				[redacted]	[redacted]		
Subtotal				[redacted]	[redacted]		
Engineering -Detail Design							Assume included in estimate above
Construction Management/GC's							Assume included in estimate above
Design Build Fee							Assume included in estimate above
TOTAL INSTALLATION DIRECT COSTS				[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]		3.0%
E&C Technical Services							
Construction Management Services			[redacted]		[redacted]		17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs				[redacted]	[redacted]		16.0%
Purchase Load (Sourcing)				[redacted]	[redacted]		7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]		14.0%
Subtotal of indirect costs above			[redacted]	[redacted]	[redacted]	15% of direct costs above	above % distribution related to this subtotal
Escalation over Life of Project							
Contingency on total project				[redacted]	[redacted]	15% of direct cost	
TOTAL INDIRECT COSTS			[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)			[redacted]	[redacted]	[redacted]		
Escalation from 2011 to 2014			[redacted]	[redacted]	[redacted]	6.5% of materials, 9.5% of labor, 6.3% of subcontracts	
TOTAL PROJECT COSTS			[redacted]	[redacted]	**$2.7M**	Overall estimate escalated from Steam Group	

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

This estimate was developed by PSCo Steam Department

##

Xcel Energy
Denver Steam Heat System
Several Rental Boilers outside Zuni Building on temporary basis
Project Capital Cost Estimate
-CONFIDENTIAL-

Option L

Revised Temporary Building Cost included

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Phase 1 (while demo is done)							
Demoltion				[redacted]	[redacted]		
Site Development				[redacted]	[redacted]	Site development around temporary building	Value assumed without analysis
Concrete				[redacted]	[redacted]	40% of SVSC for contract pad in building	
Plant Equipment	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Add stack extensions, FG reg station, central control system, FO tank	Value assumed without analysis
Instruments	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVEC x 50%	
Conveying				[redacted]	[redacted]		
Piping & Building Systems	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Specific allocation based on SVSC data	
Electrical	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVEC x 50%	
Start-up	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	SVEC x 50% + S/C (Rental company startup technician)	
Electrical Interconnect, cost of new service				[redacted]	[redacted]	Assume replacement of demolished equipment	Value assumed without analysis
City Sewer Interconnection				[redacted]	[redacted]	Upgrade	Value assumed without analysis
Subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Covers unknown period with interconnected rental equipment	
Engineering -Detail Design				[redacted]	[redacted]	40% of subtotal below	
Construction Management/GC's				[redacted]	[redacted]	37% of subtotal below	
Design Build Fee				[redacted]	[redacted]	23% of subtotal below	
Subtotal - EPC indirects and fee				[redacted]	[redacted]	20% of above subtotal	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
General Services/ Support Depts. (Environmental, Production Resources, Regulatory, Legal, etc.)			[redacted]		[redacted]		9.0%
Client Department (Plant Staff)			[redacted]		[redacted]		10.5%
E&C Project Management (Sourcing, Project Control, Admin)			[redacted]		[redacted]		10.5%
E&C Engineering			[redacted]		[redacted]	To include in Engineering Detail under direct	3.0%
E&C Technical Services			[redacted]		[redacted]	To include in Engineering Detail under direct	
Construction Management Services			[redacted]		[redacted]	Included more of this scope in CM Fee above	17.5%
Startup & Testing Services			[redacted]		[redacted]		7.5%
Professional Services			[redacted]		[redacted]		5.0%
Other Indirect Costs	[redacted]			[redacted]	[redacted]	Slight reduction due to reduction in project costs	16.0%
					[redacted]		
Purchase Load (Sourcing)				[redacted]	[redacted]	Reduced due to EPC to purchase equipment	7.0%
A&G - (Pwr Plant Overheads)				[redacted]	[redacted]	Slight reduction due to reduction in project costs	14.0%
Subtotal of indirects above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	10% of EPC directs above	above % distribution related to this subtotal for adj
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	5% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 $)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Assume 4% of total costs above	Rentals based on current quotes
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	$9.0M		

Chart Data

		12 months	24 months	36 months	48 months	Sendout
2 boilers (1/2 yr)						Summer = 0
Boiler/Transport Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	Winter = 130 kpph
WT Rental/Transport Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	
Other Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	70% of base other costs
1 all yr + 2 boilers (1/2 yr)						
Boiler/Transport Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	Summer = 65 kpph
WT Rental/Transport Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	Winter = 195 kpph
Building Rental Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	
Other Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	85% of base other costs
Total Project Cost	$	[redacted]	[redacted]	[redacted]	[redacted]	
2 all yr + 2 boilers (1/2 yr)						
Boiler/Transport Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	Summer = 130 kpph
WT Rental/Transport Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	Winter = 260 kpph
Building Rental Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	
Other Costs	$	[redacted]	[redacted]	[redacted]	[redacted]	
Total Project Cost	$	[redacted]	[redacted]	[redacted]	[redacted]	
			[redacted]			

[redacted]

Annual costs that need to be included in financial analysis, and are not included in capital cost estimate above

Temporary Building			[redacted]	[redacted]	[redacted]	Temporary Building leased @ $9.5k/mo for 2 years, one time installation cost
Auxiliary Rental Trailers	[redacted]		[redacted]	[redacted]	[redacted]	4 units, 2@12 mo, 2@24 mo, + transportation ($5k) 8 ways
Boiler rental 75kpph	[redacted]		[redacted]	[redacted]	[redacted]	4 units, 2@12 mo, 2@24 mo, + transportation ($15k) 8 ways

The variation in annual costs depending on assumptions of duration and capacity are provided in the table and graphs (above right)

##

Xcel Energy
Denver Steam Heat System
Minimum Investment for Short-Term Continued Operation of Zuni Unit 1A Boiler
Project Capital Cost Estimate
-CONFIDENTIAL-

Option Z1

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]		
Concrete				[redacted]	[redacted]	Stack Recoating	
Masonry				[redacted]	[redacted]		
Structural Steel				[redacted]	[redacted]		
Roofing & Siding				[redacted]	[redacted]	Additional roof repairs	
Doors & Windows				[redacted]	[redacted]		
Architectural Finishes				[redacted]	[redacted]		
Plant Equipment				[redacted]	[redacted]	Boiler refractory, FW heater repairs, pump rebuild, WT filters	
Office Space					[redacted]		
Furnishings					[redacted]		
Instruments				[redacted]	[redacted]	Flame Scanners, Instrument/Controls Upgrades, CEMS, add to ABB C700 system	
Conveying				[redacted]	[redacted]		
Piping & Building Systems				[redacted]	[redacted]	Repair hangers, fix fibercast pipe, add new sendout meter	
Electrical				[redacted]	[redacted]	Xcel decision not to replace equipment in next 5 years.	
Start-up				[redacted]	[redacted]		
Electrical Interconnect, cost of new service				[redacted]	[redacted]		
Gas Service Upgrade				[redacted]	[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]		
City Sewer Interconnection				[redacted]	[redacted]	Ugrade needed when ponds are retired and land sold.	
subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]		
Construction Management/GC's				[redacted]	[redacted]		
Design Build Fee				[redacted]	[redacted]		
Subtotal - EPC indirects and fee				[redacted]	[redacted]	Tasks managed individually by Xcel	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Indirect Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	15% of direct costs above	costs not distributed to categories
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	10% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Costs estimated in 2014 as part of Xcel Assessment work	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	**$1.9M**		

Additional O&M costs not included here.
Some savings expected if Options Z1 and Z2 are done together.

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

##

Xcel Energy
Denver Steam Heat System
Minimum Investment for Short-Term Continued Operation of Zuni Unit 2 Boiler
Project Capital Cost Estimate
-CONFIDENTIAL-

Option Z2

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	Equipment Cost	Sales/Use Tax 7.62%	Install Cost	Sub-Contracts	Total Cost	Note	Comment
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]		
Concrete				[redacted]	[redacted]		
Masonry				[redacted]	[redacted]		
Structural Steel				[redacted]	[redacted]		
Roofing & Siding				[redacted]	[redacted]	Additional roof repairs	
Doors & Windows				[redacted]	[redacted]		
Architectural Finishes				[redacted]	[redacted]		
Plant Equipment				[redacted]	[redacted]	New condensate transfer pump capacity, rebuild BFPa, WT filters	
Office Space					[redacted]		
Furnishings					[redacted]		
Instruments				[redacted]	[redacted]	Flame Scanners, Instrument/Controls Upgrades, CEMS, add to ABB C700 system	
Conveying				[redacted]	[redacted]		
Piping & Building Systems				[redacted]	[redacted]	Repair hangers, fix fibercast pipe, add new sendout meter	
Electrical				[redacted]	[redacted]	Xcel decision not to replace equipment in next 5 years.	
Start-up				[redacted]	[redacted]		
Electrical Interconnect, cost of new service				[redacted]	[redacted]		
Gas Service Upgrade				[redacted]	[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]		
City Sewer Interconnection				[redacted]	[redacted]	Ugrade needed when ponds are retired and land sold.	
subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]		
Construction Management/GC's				[redacted]	[redacted]		
Design Build Fee				[redacted]	[redacted]		
Subtotal - EPC indirects and fee				[redacted]	[redacted]	Tasks managed individually by Xcel	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Indirect Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	15% of direct costs above	costs not distributed to categories
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	10% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Costs estimated in 2014 as part of Xcel Assessment work	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	**$3.0M**		

Additional O&M costs not included here.
Some savings expected if Options Z1 and Z2 are done together.

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

##

Xcel Energy
Denver Steam Heat System
Minimum Investment for Short-Term Continued Operation of Both Zuni Unit 1A and 2 Boilers
Project Capital Cost Estimate
-CONFIDENTIAL-

Option Z1+Z2

Project Description/Scope Definition:	Equipment/Material		Labor				
Description	**Equipment Cost**	**Sales/Use Tax 7.62%**	**Install Cost**	**Sub-Contracts**	**Total Cost**	**Note**	**Comment**
Demoltion				[redacted]	[redacted]	Demo in Zuni in Electric Budget	
Site Development				[redacted]	[redacted]		
Concrete - Unit 1A				[redacted]	[redacted]	1A Stack Recoating	
Masonry				[redacted]	[redacted]		
Structural Steel				[redacted]	[redacted]		
Roofing & Siding - Common				[redacted]	[redacted]	Additional roof repairs	
Doors & Windows				[redacted]	[redacted]		
Architectural Finishes				[redacted]	[redacted]		
Plant Equipment - Unit 1A				[redacted]	[redacted]	FW heater repairs, pump rebuild	
Plant Equipment - Unit 2				[redacted]	[redacted]	New condensate transfer pump capacity, rebuild BFPa	
Plant Equipment - Common				[redacted]	[redacted]	WT Filters	
Office Space					[redacted]		
Furnishings					[redacted]		
Instruments - Unit 1A				[redacted]	[redacted]	Flame Scanners, Instrument/Controls Upgrades, CEMS, add to ABB C700 system	
Instruments - Unit 2				[redacted]	[redacted]	Flame Scanners, Instrument/Controls Upgrades, CEMS, add to ABB C700 system	
Instruments - Common				[redacted]	[redacted]	Sendout Steam Controls	
Conveying				[redacted]	[redacted]		
Piping & Building Systems - Unit 1A				[redacted]	[redacted]	Repair hangers, fix fibercast pipe, add new sendout meter	
Piping & Building Systems - Unit 2				[redacted]	[redacted]	Repair hangers, fix fibercast pipe	
Electrical - Common				[redacted]	[redacted]	Xcel decision not to replace equipment in next 5 years.	
Start-up				[redacted]	[redacted]		
Electrical Interconnect, cost of new service				[redacted]	[redacted]		
Gas Service Upgrade				[redacted]	[redacted]	Gas service Existing	
Steam Interconnection		[redacted]			[redacted]	Steam Connection existing	
City Water Interconnection				[redacted]	[redacted]		
City Sewer Interconnection - Common				[redacted]	[redacted]	Ugrade needed when ponds are retired and land sold.	
subtotal of above	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Engineering -Detail Design				[redacted]	[redacted]		
Construction Management/GC's				[redacted]	[redacted]		
Design Build Fee				[redacted]	[redacted]		
Subtotal - EPC indirects and fee				[redacted]	[redacted]	Tasks managed individually by Xcel	
TOTAL INSTALLATION DIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Indirect Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	15% of direct costs above	costs not distributed to categories
Escalation over Life of Project					[redacted]		
Contingency on total project				[redacted]	[redacted]	Review based on budget pricing	10% direct costs
TOTAL INDIRECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
TOTAL PROJECT COSTS (2011 Dollars)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
Escalate pricing from 2011 to 2014	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Costs estimated in 2014 as part of Xcel Assessment work	
TOTAL PROJECT COSTS	[redacted]	[redacted]	[redacted]	[redacted]	**$4.2M**		

Additional O&M costs not included here.

CONFIDENTIAL INFORMATION HAS BEEN REDACTED

Thermal Energy
Direct Labor Operations and Maintenance Head Count

Operations	Job Descriptions	Current (Thermal Portion Only)	Option A Original Sun Valley Steam Center	Option B Modified Sun Valley Steam Center	Option C 2 New pkg boilers in Zuni Building	Option D 1 New pkg boiler in Zuni Building	Option E Zuni 1A extension > 10 year (post 2015)	Option F Zuni 2 extension > 10 year (post 2015)	Option G 1 New pkg boiler in Cherokee Steam Building	Option H Several Used pkg boilers in Zuni Building	Option I Operate (Other) Steam, connect to IP lines	Option J 1 New pkg boiler in Expanded DSP Building	Option K Connect State to IP lines	Option L Rental boilers outside Zuni Building	Option Z1 Minimum Investment in Zuni 1A, up to 5 years	Option Z2 Minimum Investment in Zuni 2, up to 5 years	Option Z1+Z2 Minimum Investment in Zuni 1A and 2, up to 5 years
Zuni or Sun Valley																	
	CS	4	0	0	0	0	6 *	6 *	0	0	0	0	0	0	6 *	6 *	6 *
	PSA	0	6	6	6	6	3 *	3 *	0	6	0	0	0	6	3 *	3 *	3 *
	Mechanics	0	2	2	2	2	2	2	0	2	0	0	0	1	2	2	2
	Electricians	0	2	2	2	2	2	2	0	2	0	0	0	2	2	2	2
	I & C Tech	0	1	1	1	1	1	1	0	1	0	0	0	1	1	1	1
	Manager	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	**4**	**12**	**12**	**11**	**11**	**14**	**14**	**0**	**11**	**0**	**0**	**0**	**10**	**14**	**14**	**14**
DSP & State																	
	CS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PSA	6	6	6	6	6	6	6	6	6	6	6	8	6	6	6	6
	Mechanics	4	4	4	4	4	4	4	5	4	6	6	4	4	4	4	4
	Electricians	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0
	I & C Tech	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
	Manager	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
	Subtotal	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**16**	**12**	**17**	**16**	**14**	**12**	**12**	**12**	**12**
Cherokee Steam or Other (incremental)																	
	CS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PSA	0	0	0	0	0	0	0	6	0	6	0	0	0	0	0	0
	Mechanics	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Electricians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	I & C Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Manager	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	0	0	0	0	0	0	0	6	0	6	0	0	0	0	0	0
	Total	**16**	**24**	**24**	**23**	**23**	**26**	**26**	**22**	**23**	**23**	**16**	**14**	**22**	**26**	**26**	**26**

Notes

1. Currently there are 14 people working at Zuni. Per prior agreement of many years ago Thermal pays for 4 people, Electric carries the balance of 10 people
2. All numbers are based on Zuni Station electric service retired 12/31/2015
3. We have assumed any Option involving Zuni Station and existing equipment or facilities will require Thermal to absorb all personnel and their associated costs.
4. ***** CS positions will become PSAs once electric has been retired at Zuni

Thermal Energy
Estimated O M Costs for Options

Categaories	Current Zuni O&M (prior to Electric retirement)	Option A Original Sun Valley Steam Center	Option B Modified Sun Valley Steam Center	Option C 2 New pkg boilers in Zuni Building	Option D 1 New pkg boiler in Zuni Building	Option E Zuni 1A extension > 10 year (post 2015)	Option F Zuni 2 extension > 10 year (post 2015)	Option G 1 New pkg boiler in Cherokee Steam Building	Option H Several Used pkg boilers in Zuni Building	Option I Operate (Other) Steam, connect to IP lines	Option J 1 New pkg boiler in Expanded DSP Building	Option K Connect State to IP lines	Option L Rental boilers outside Zuni Building	Option Z1 Minimum Investment in Zuni 1A, up to 5 years	Option Z2 Minimum Investment in Zuni 2, up to 5 years	Option Z1+Z2 Minimum Investment in Zuni 1A and 2, up to 5 years
Existing Zuni Boiler Status	1A & 2 operating	Both retired	Both retired	Both retired	Both retired	1A operating	2 operating	Both retired	Both retired	Both retired	Both retired	Both retired	Both retired	1A operating	2 operating	1A & 2 operating
Direct O&M Headcount																
Base O&M Headcount	DSP + State	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Incremental O&M Headcour	for Option	12	12	11	11	14	14	10	11	11	4	2	10	14	14	14
Total O&M Headcount	DSP + State + Option	24	24	23	23	26	26	22	23	23	16	14	22	26	26	26
Labor Costs																
Base Direct Labor	$ [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Incremental Direct Labor	$ -	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Subtotal Labor Costs	$ [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Non-Labor Costs																
Maintainence (Mat & Lab)	$ [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Water	$ [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Sewer	$ [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
House Power	[redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Miscellaneous	$ [redacted]	$ [redacted]	[redacted] [redacted]	[redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Leased Equipment Costs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted] [redacted]	[redacted]	[redacted]	[redacted]
Subtotal Non-Labor Costs	$ [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Totals	**$ 3,240**	**$ 4,010**	**$ 4,010**	**$ 4,220**	**$ 3,970**	**$ 4,840**	**$ 4,840**	**$ 3,780**	**$ 4,270**	**$ 3,670**	**$ 2,940**	**$ 2,435**	**$ 6,025**	**$ 4,565**	**$ 4,565**	**$ 4,565**
Base Non-Labor Costs	DSP + State	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Incremental Non-Labor Cost	for Option	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	$ [redacted]	[redacted] [redacted]	[redacted] [redacted]
Total Incremental O&M Cost	for Option	$ 2,330	$ 2,330	$ 2,540	$ 2,290	$ 3,160	$ 3,160	$ 2,100	$ 2,590	$ 1,990	$ 1,260	$ 755	$ 4,345	$ 2,885	$ 2,885	$ 2,885

Notes

1. All cost values are $1000
2. Sun Valley and Sun Valley Lite O&M = previously filed costs
3. All figures are based on Zuni Station electric service retired 12/31/2015
4. Direct Labor Costs from companion Spreadsheet, based on $140,000 equivalent annual cost per person, which includes 92.68% loading per Wilcox.
5. Depreciation of Assets not included in these costs.
6. Total Incremental O&M Costs include Incremental Direct Labor Costs and Incremental Non-Labor Costs.
7. Miscellaneous non-labor costs include a variety of minor things and Corporate overheads.
8. Changes in the costs of chemicals for the options was not specifically estimated, since customer load factor is not directly included in this analysis.
9. Option L excludes one-time integration costs for rental boilers, but is considered O&M cost in first year.

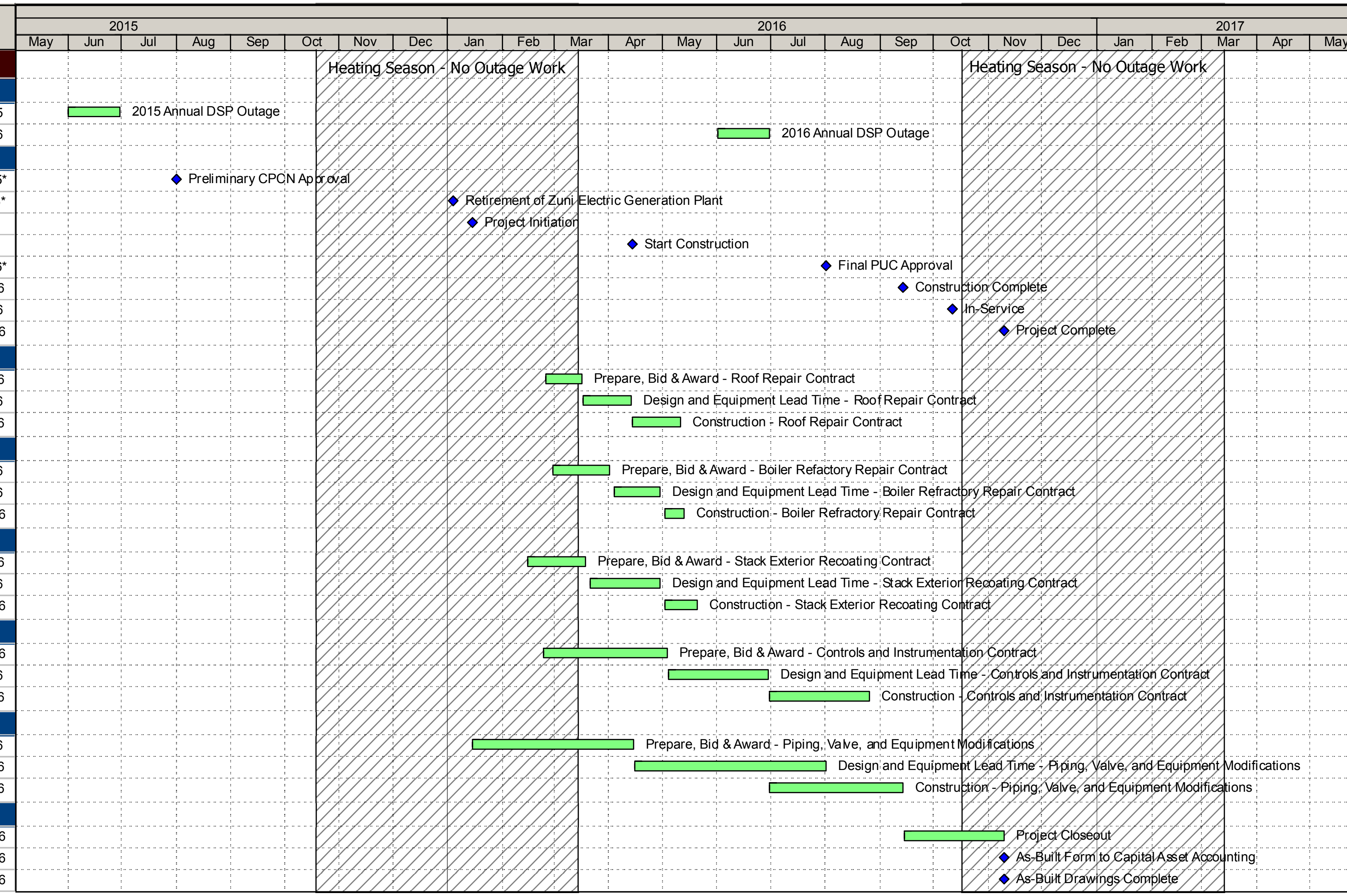
CONFIDENTIAL INFORMATION HAS BEEN REDACTED

DENVER STEAM PLANT		INVESTIGATION NO.: 2014-208	Xcel Energy PUBLIC SERVICE COMPANY
NE1/4 OF SECTION 33	TOWNSHIP: 3 SOUTH RANGE: 68 WEST	SCALE: 1"=60'	PSCo PROPERTY
6TH PRINCIPAL MERIDIAN	CITY AND COUNTY OF DENVER, COLORADO	DRAWN BY: CAH	
PLAT NO.: N/A	DOCUMENT NO.: 177 AGENT: J. HANSON	DATE: 08-19-14	IMAGERY: GOOGLE EARTH

N

DWG:INV2014-208JH_EXHIBIT-1.dwg

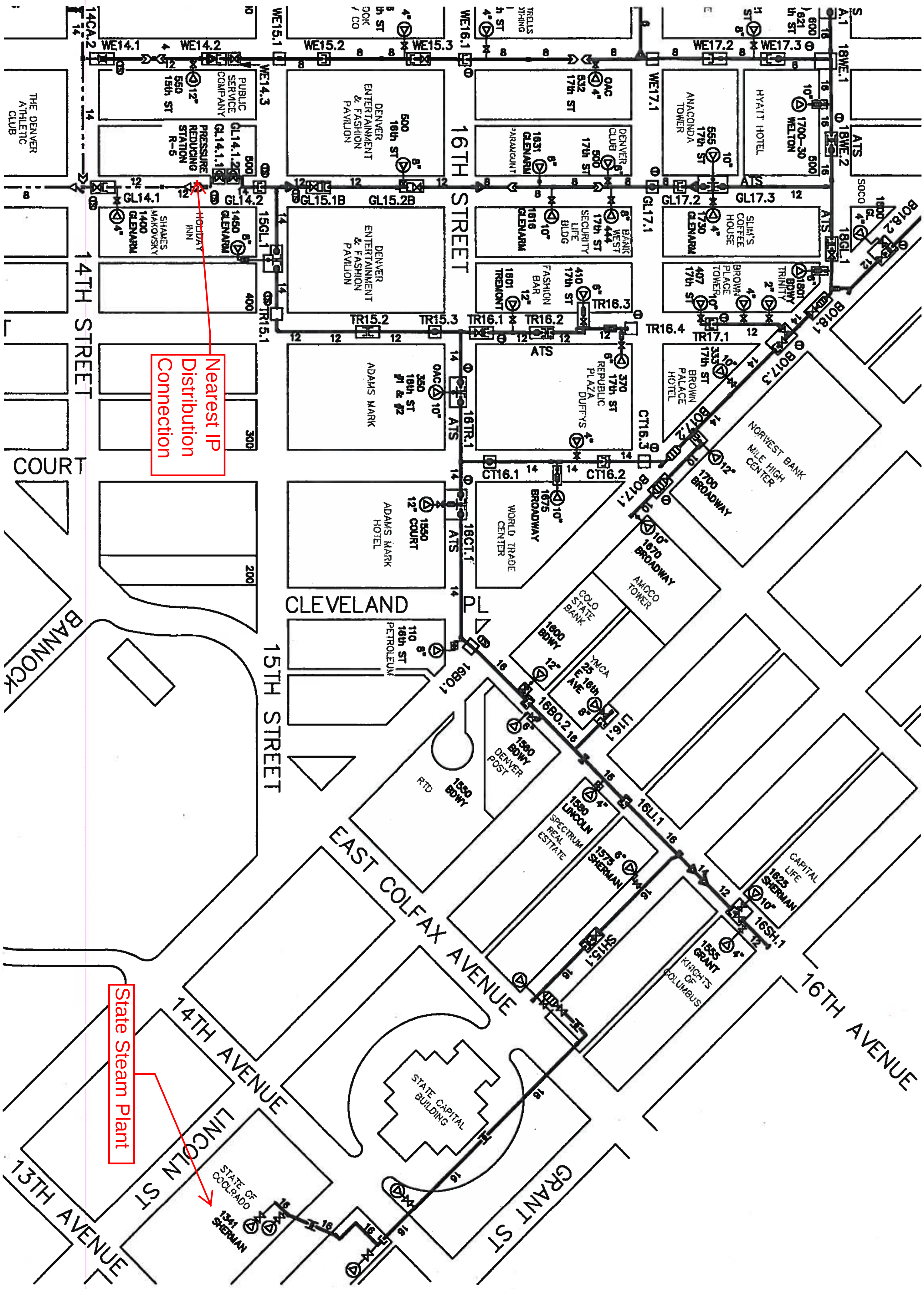
Activity ID	Activity Name	Original Duration	Start	Finish
Zuni 1A Modification				
DSP Planned Maintenance Outage				
M1010	2015 Annual DSP Outage	29	01-Jun-15*	30-Jun-15
M1020	2016 Annual DSP Outage	29	01-Jun-16*	30-Jun-16
Project Milestones				
A1090	Preliminary CPCN Approval	0		01-Aug-15*
A1050	Retirement of Zuni Electric Generation Plant	0		04-Jan-16*
A1000	Project Initiation	0	15-Jan-16*	
A1070	Start Construction	0	14-Apr-16	
A1100	Final PUC Approval	0		01-Aug-16*
A1030	Construction Complete	0		13-Sep-16
A1040	In-Service	0		11-Oct-16
A1010	Project Complete	0		09-Nov-16
Roof Repair				
B1050	Prepare, Bid & Award - Roof Repair Contract	15	25-Feb-16	16-Mar-16
E1050	Design and Equipment Lead Time - Roof Repair Contract	20	17-Mar-16	13-Apr-16
C1050	Construction - Roof Repair Contract	20	14-Apr-16	11-May-16
Boiler Refractory Repair				
B1010	Prepare, Bid & Award - Boiler Refactory Repair Contract	25	29-Feb-16	01-Apr-16
E1010	Design and Equipment Lead Time - Boiler Refractory Repair Contract	20	04-Apr-16	29-Apr-16
C1010	Construction - Boiler Refractory Repair Contract	10	02-May-16	13-May-16
Stack Exterior Recoating				
B1020	Prepare, Bid & Award - Stack Exterior Recoating Contract	25	15-Feb-16	18-Mar-16
E1020	Design and Equipment Lead Time - Stack Exterior Recoating Contract	30	21-Mar-16	29-Apr-16
C1020	Construction - Stack Exterior Recoating Contract	15	02-May-16	20-May-16
Controls and Instrumentation Upgrade				
B1030	Prepare, Bid & Award - Controls and Instrumentation Contract	50	24-Feb-16	03-May-16
E1030	Design and Equipment Lead Time - Controls and Instrumentation Contract	40	04-May-16	29-Jun-16
C1030	Construction - Controls and Instrumentation Contract	40	30-Jun-16	25-Aug-16
Piping, Valve, and Equipment Modifications				
B1040	Prepare, Bid & Award - Piping, Valve, and Equipment Modifications	65	15-Jan-16	14-Apr-16
E1040	Design and Equipment Lead Time - Piping, Valve, and Equipment Modifications	75	15-Apr-16	01-Aug-16
C1040	Construction - Piping, Valve, and Equipment Modifications	52	30-Jun-16	13-Sep-16
Project Closeout				
PC1000	Project Closeout	41	14-Sep-16	09-Nov-16
PC1010	As-Built Form to Capital Asset Accounting	0		09-Nov-16
PC1020	As-Built Drawings Complete	0		09-Nov-16



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Critical Milestone
Completed Milestone

Zuni 1A Modification
Preliminary Schedule

Date	Revision	Checked	Approved
25-Nov-14	Rev 2		

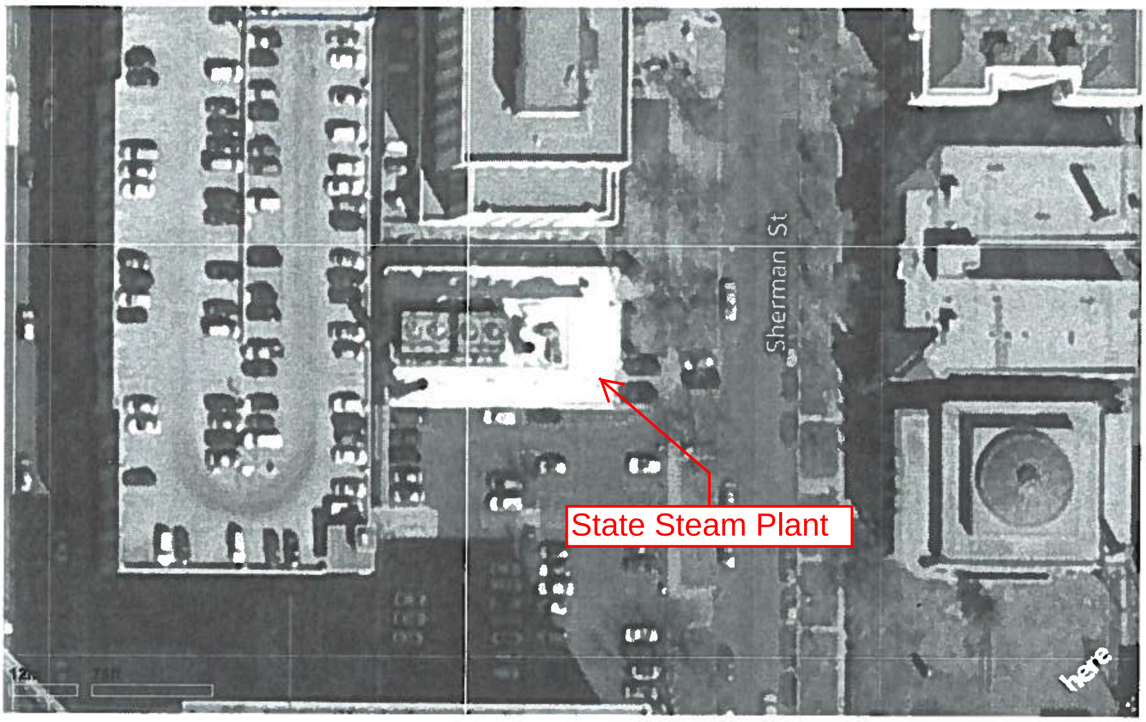

Nearest IP Distribution Connection
State Steam Plant
16TH STREET
14TH STREET
15TH STREET
COURT
CLEVELAND PL
BANNOCK
EAST COLFAX AVENUE
14TH AVENUE
13TH AVENUE
16TH AVENUE
LINCOLN ST
GRANT ST
STATE CAPITAL BUILDING
STATE OF COLORADO
1341 SHERMAN
THE DENVER ATHLETIC CLUB
PUBLIC SERVICE COMPANY
PRESSURE REDUCING STATION R-5
HOLIDAY INN
DENVER ENTERTAINMENT & FASHION PAVILION
ADAMS MARK
ADAMS MARK HOTEL
WORLD TRADE CENTER
REPUBLIC PLAZA
BROWN PALACE HOTEL
NORWEST BANK MILE HIGH CENTER
AMOCO TOWER
COLO STATE BANK
YMCA
DENVER POST
RTD
SPECTRUM REAL ESTATE
CAPITAL LIFE
KNIGHTS OF COLUMBUS
ANACONDA TOWER
HYATT HOTEL
DENVER CLUB
SECURITY LIFE BLDG
BROWN PLACE TOWER
SLIM'S COFFEE HOUSE
FASHION BAR
PETROLEUM

Print

YAHOO! MAPS

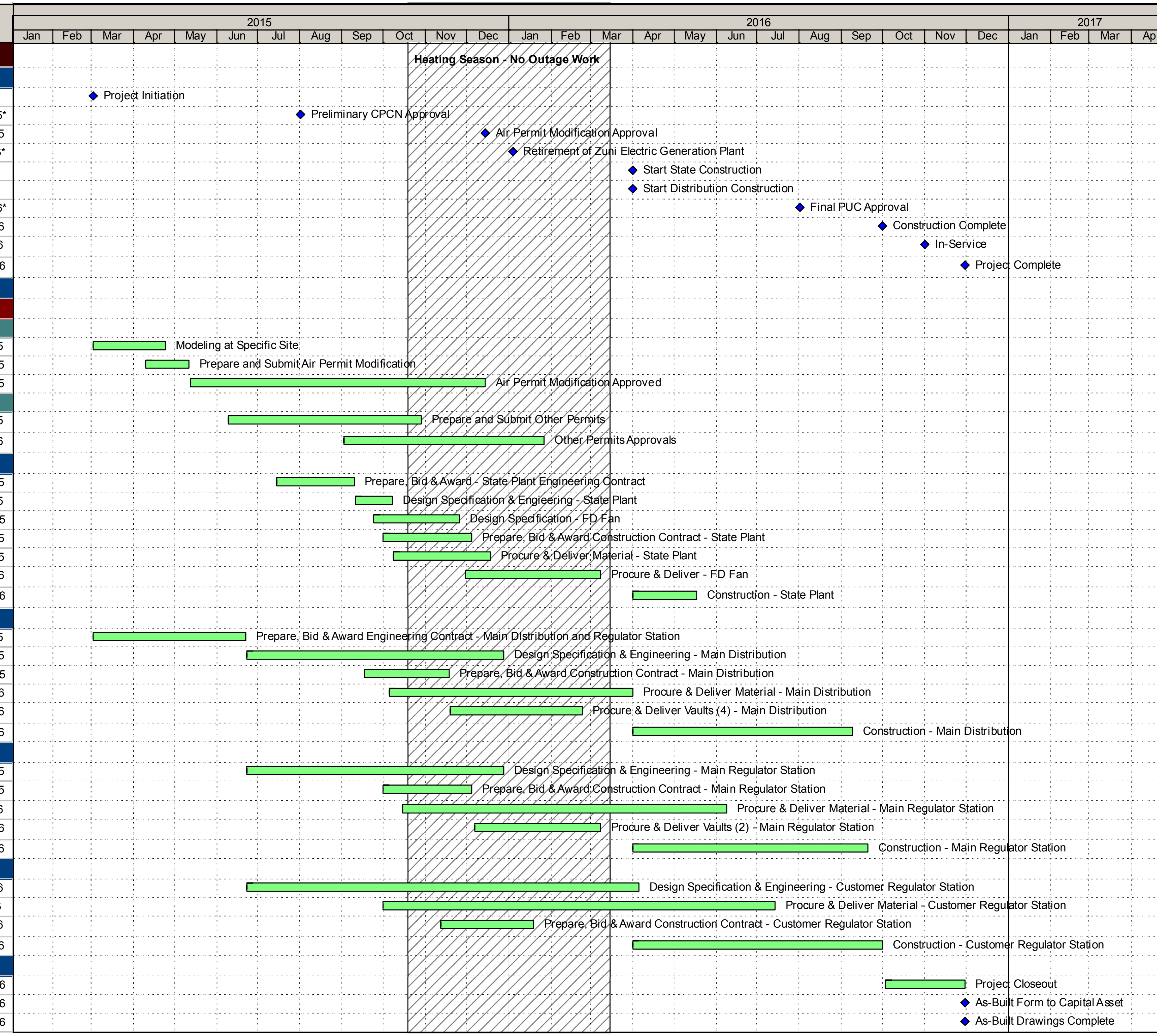
Denver, CO 80202

Enter notes here
255



When using any driving directions or map, it is a good idea to double check and make sure the road still exists, watch out for construction, and follow all traffic safety precautions. This is only to be used as an aid in planning

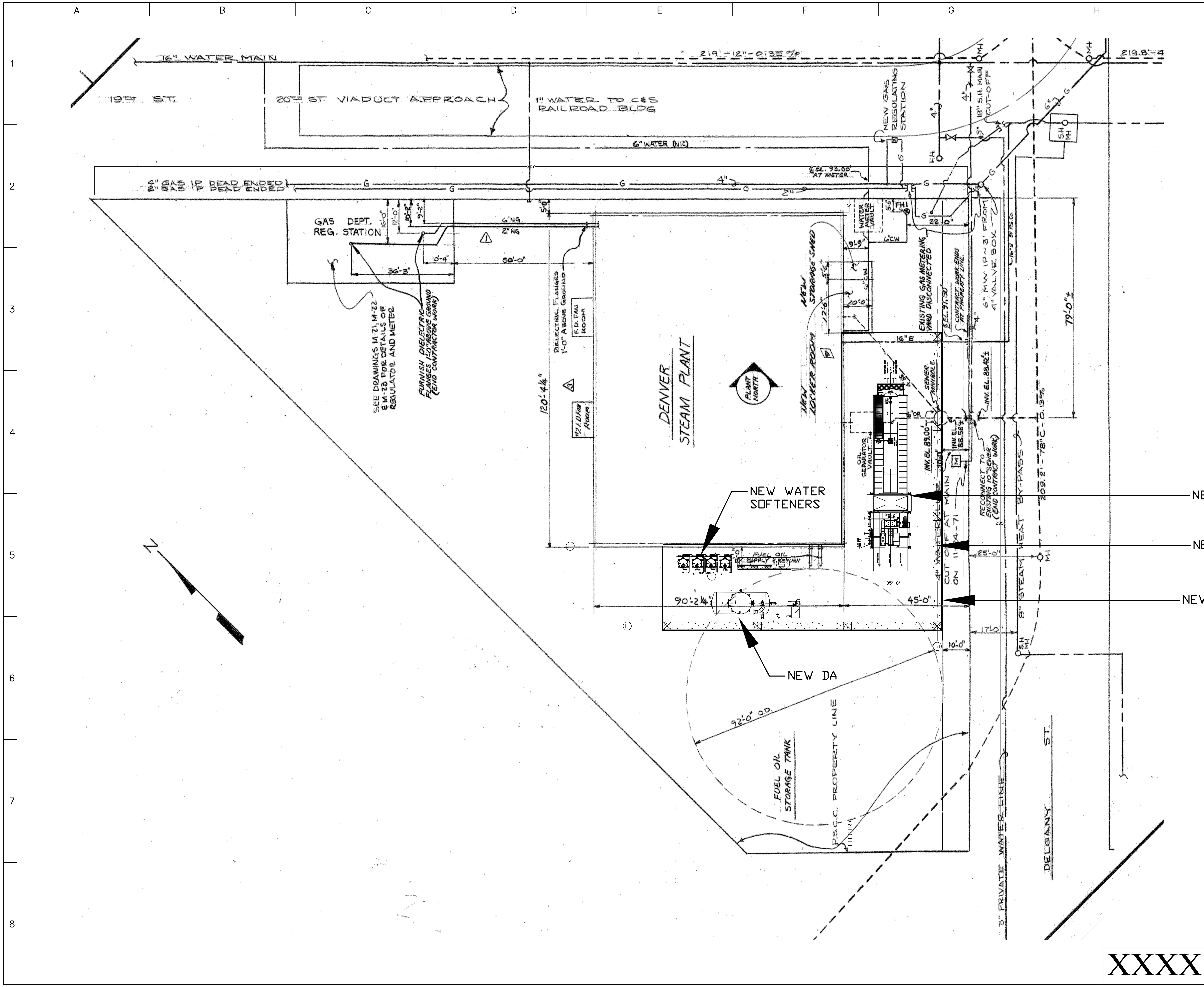
Activity ID	Activity Name	Original Duration	Start	Finish
Upgrade State Plant to IP System				
Project Milestones				
A1000	Project Initiation	0	02-Mar-15*	
A1090	Preliminary CPCN Approval	0		01-Aug-15*
A1020	Air Permit Modification Approval	0		14-Dec-15
A1050	Retirement of Zuni Electric Generation Plant	0		04-Jan-16*
A1070	Start State Construction	0	01-Apr-16	
A1080	Start Distribution Construction	0	01-Apr-16	
A1100	Final PUC Approval	0		01-Aug-16*
A1030	Construction Complete	0		30-Sep-16
A1040	In-Service	0		31-Oct-16
A1010	Project Complete	0		30-Nov-16
Project Development				
Permitting				
Air Quality Permit				
D1010	Modeling at Specific Site	40	02-Mar-15	24-Apr-15
D1120	Prepare and Submit Air Permit Modification	22	10-Apr-15	11-May-15
D1020	Air Permit Modification Approved	150	12-May-15	14-Dec-15
Other Permits				
D1130	Prepare and Submit Other Permits	100	09-Jun-15	28-Oct-15
D1140	Other Permits Approvals	100	02-Sep-15	26-Jan-16
State Plant				
B1000	Prepare, Bid & Award - State Plant Engineering Contract	40	15-Jul-15*	09-Sep-15
E1000	Design Specification & Engieering - State Plant	20	10-Sep-15	07-Oct-15
E1010	Design Specification - FD Fan	45	24-Sep-15	25-Nov-15
B1030	Prepare, Bid & Award Construction Contract - State Plant	45	01-Oct-15	04-Dec-15
P1000	Procure & Deliver Material - State Plant	50	08-Oct-15	18-Dec-15
P1010	Procure & Deliver - FD Fan	70	30-Nov-15	08-Mar-16
C1000	Construction - State Plant	33	01-Apr-16	17-May-16
Main Distribution (6)				
B1010	Prepare, Bid & Award Engineering Contract - Main DIstribution and Regulator Station	80	02-Mar-15	22-Jun-15
E1020	Design Specification & Engineering - Main Distribution	130	23-Jun-15	28-Dec-15
B1040	Prepare, Bid & Award Construction Contract - Main Distribution	45	17-Sep-15	18-Nov-15
P1020	Procure & Deliver Material - Main Distribution	125	05-Oct-15	31-Mar-16
P1050	Procure & Deliver Vaults (4) - Main Distribution	65	19-Nov-15	23-Feb-16
C1010	Construction - Main Distribution	112	01-Apr-16*	08-Sep-16
Main Regulator Station (2)				
E1030	Design Specification & Engineering - Main Regulator Station	130	23-Jun-15	28-Dec-15
B1060	Prepare, Bid & Award Construction Contract - Main Regulator Station	45	01-Oct-15	04-Dec-15
P1030	Procure & Deliver Material - Main Regulator Station	165	15-Oct-15	08-Jun-16
P1060	Procure & Deliver Vaults (2) - Main Regulator Station	65	07-Dec-15	08-Mar-16
C1020	Construction - Main Regulator Station	120	01-Apr-16*	20-Sep-16
Customer Regulator Station (18)				
E1040	Design Specification & Engineering - Customer Regulator Station	200	23-Jun-15	05-Apr-16
P1040	Procure & Deliver Material - Customer Regulator Station	200	01-Oct-15	14-Jul-16
B1050	Prepare, Bid & Award Construction Contract - Customer Regulator Station	45	12-Nov-15	19-Jan-16
C1030	Construction - Customer Regulator Station	128	01-Apr-16*	30-Sep-16
Project Closeout				
PC1000	Project Closeout	41	03-Oct-16	30-Nov-16
PC1010	As-Built Form to Capital Asset	0		30-Nov-16
PC1020	As-Built Drawings Complete	0		30-Nov-16



Actual Work | Critical Remaining Work | Critical Milestone
Remaining Work | Milestone | Completed Milestone

Upgrade State Plant to IP System
Preliminary Schedule

Date	Revision	Checked	Approved
25-Nov-14	Rev 4		



REFERENCE DRAWINGS		
DWG NO.	MANUFACTURER	DRAWING TITLE

NO	REVISION	ZONE	DATE	BY	CHK	ENG

PMI Project Management, Inc.
Engineering & Construction Management
10715 Highland View Ct
Littleton CO 80124
(303) 297-1089

DENVER STEAM HEAT

DISTRIBUTION SYSTEM
DSP THIRD BOILER
PLAN

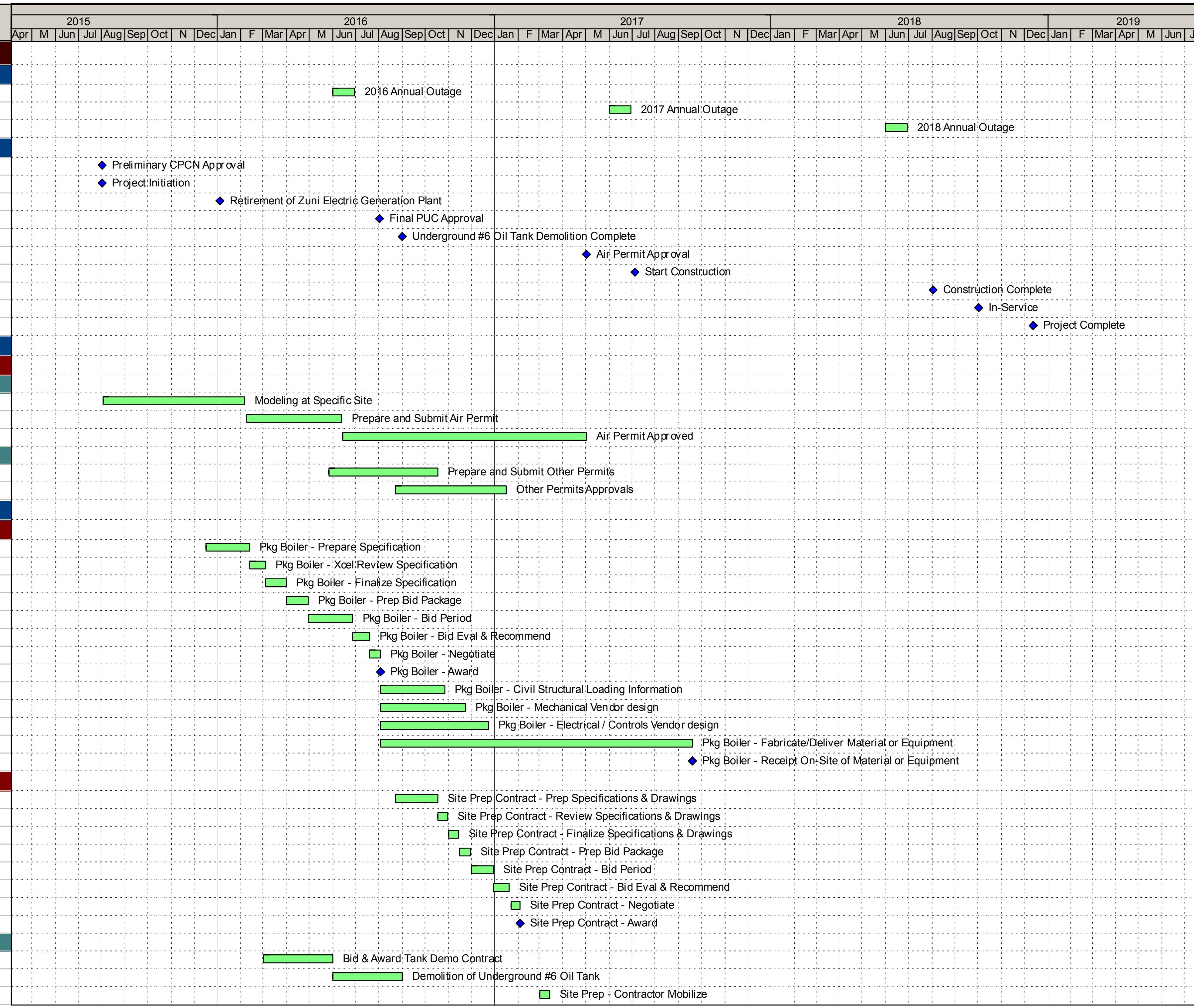
Xcel Energy®
PUBLIC SERVICE COMPANY OF COLORADO

XXXX

DWN: RGB	DATE: 04-28-14	CHK: GH	DATE: 00-00-00	PROJ. NO: 0000000
ENG: RGB	DATE: 04-28-14	CHK: XXX	DATE: 00-00-00	SCALE: NONE
PM: XXX	DATE: 00-00-00	53-XX.XXX		SHEET 1 REV 0
APVD: XXX	DATE: 00-00-00			

MF NO 0000

Activity ID	Activity Name	Original Duration	Start	Finish
Denver Steam Plant Boiler 3				
DSP Planned Maintenance Outage				
M1010	2016 Annual Outage	29	01-Jun-16*	30-Jun-16
M1020	2017 Annual Outage	29	01-Jun-17*	30-Jun-17
M1030	2018 Annual Outage	29	01-Jun-18*	30-Jun-18
Project Milestones				
A1090	Preliminary CPCN Approval	0		01-Aug-15*
A1000	Project Initiation	0	01-Aug-15	
A1050	Retirement of Zuni Electric Generation Plant	0		04-Jan-16*
A1110	Final PUC Approval	0		01-Aug-16*
A1100	Underground #6 Oil Tank Demolition Complete	0		31-Aug-16
A1020	Air Permit Approval	0		01-May-17
A1070	Start Construction	0	05-Jul-17	
A1030	Construction Complete	0		02-Aug-18
A1040	In-Service	0		01-Oct-18
PC1030	Project Complete	0		12-Dec-18
Project Development				
Permitting				
Air Quality Permit				
D1010	Modeling at Specific Site	130	03-Aug-15	05-Feb-16
D1120	Prepare and Submit Air Permit	90	08-Feb-16	13-Jun-16
D1020	Air Permit Approved	224	14-Jun-16	01-May-17
Other Permits				
D1130	Prepare and Submit Other Permits	100	27-May-16	18-Oct-16
D1140	Other Permits Approvals	100	23-Aug-16	16-Jan-17
Procurement				
Packaged Boiler Procurement				
P1120	Pkg Boiler - Prepare Specification	40	16-Dec-15	12-Feb-16
P1220	Pkg Boiler - Xcel Review Specification	15	12-Feb-16	04-Mar-16
P1230	Pkg Boiler - Finalize Specification	20	04-Mar-16	01-Apr-16
P1000	Pkg Boiler - Prep Bid Package	20	01-Apr-16	29-Apr-16
P1030	Pkg Boiler - Bid Period	40	29-Apr-16	27-Jun-16
P1040	Pkg Boiler - Bid Eval & Recommend	15	27-Jun-16	19-Jul-16
P1050	Pkg Boiler - Negotiate	10	19-Jul-16	02-Aug-16
P1060	Pkg Boiler - Award	0		02-Aug-16
P1130	Pkg Boiler - Civil Structural Loading Information	60	02-Aug-16	26-Oct-16
P1140	Pkg Boiler - Mechanical Vendor design	80	02-Aug-16	23-Nov-16
P1150	Pkg Boiler - Electrical / Controls Vendor design	100	02-Aug-16	23-Dec-16
P1010	Pkg Boiler - Fabricate/Deliver Material or Equipment	286	02-Aug-16	18-Sep-17
P1020	Pkg Boiler - Receipt On-Site of Material or Equipment	0		18-Sep-17
Site Preparation Contract				
P1170	Site Prep Contract - Prep Specifications & Drawings	40	22-Aug-16*	17-Oct-16
P1260	Site Prep Contract - Review Specifications & Drawings	10	18-Oct-16	31-Oct-16
P1270	Site Prep Contract - Finalize Specifications & Drawings	10	01-Nov-16	14-Nov-16
P1180	Site Prep Contract - Prep Bid Package	10	15-Nov-16	30-Nov-16
P1190	Site Prep Contract - Bid Period	20	01-Dec-16	29-Dec-16
P1200	Site Prep Contract - Bid Eval & Recommend	15	30-Dec-16	20-Jan-17
P1210	Site Prep Contract - Negotiate	10	23-Jan-17	03-Feb-17
P1280	Site Prep Contract - Award	0		03-Feb-17
Site Prep Construction				
C1100	Bid & Award Tank Demo Contract	65	01-Mar-16*	01-Jun-16
C1110	Demolition of Underground #6 Oil Tank	64	01-Jun-16	31-Aug-16
C1010	Site Prep - Contractor Mobilize	10	01-Mar-17	14-Mar-17

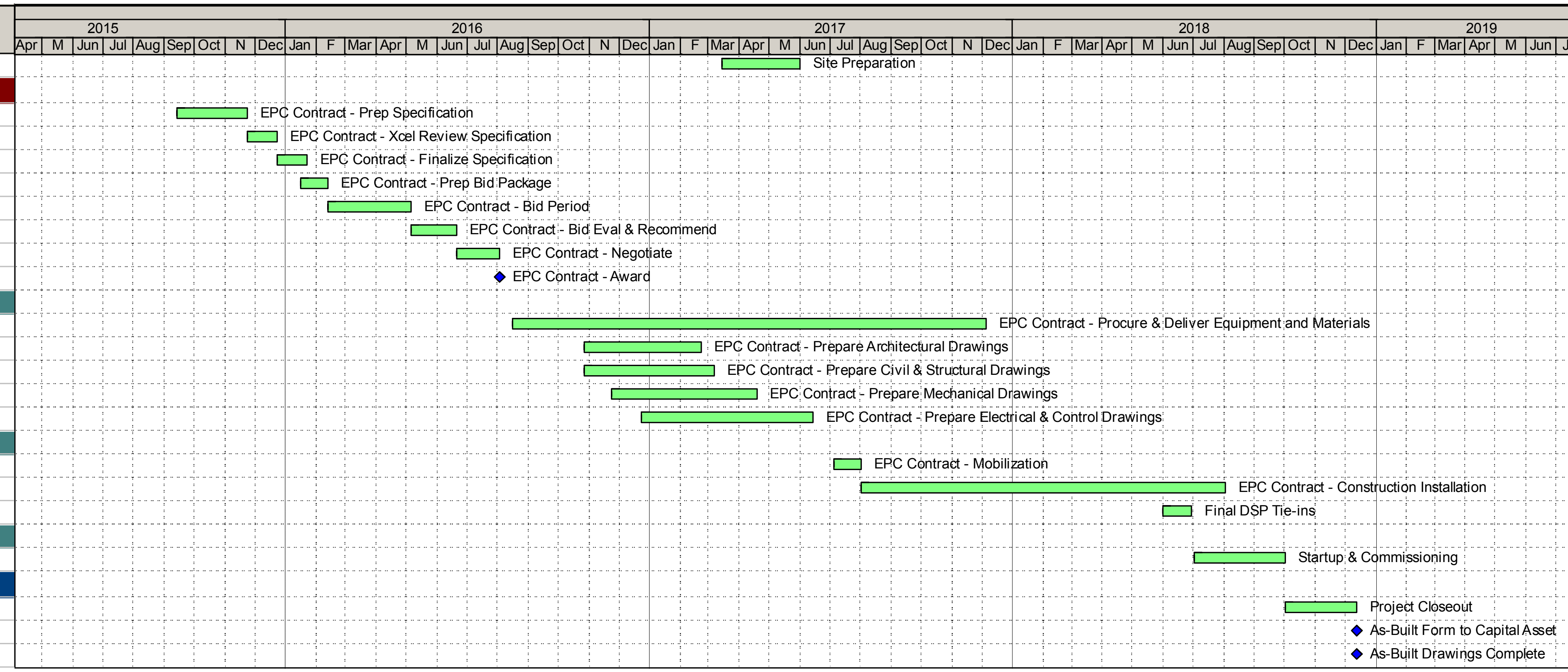


Actual Work — Critical Remaining Work — Critical Milestone
Remaining Work — Milestone — Completed Milestone

Denver Steam Plant Boiler 3
Preliminary Schedule

Date	Revision	Checked	Approved
25-Nov-14	Rev 4		

Activity ID	Activity Name	Original Duration	Start	Finish
C1020	Site Preparation	56	15-Mar-17	01-Jun-17
EPC Contract				
P1110	EPC Contract - Prep Specification	50	14-Sep-15	23-Nov-15
P1240	EPC Contract - Xcel Review Specification	20	23-Nov-15	23-Dec-15
P1250	EPC Contract - Finalize Specification	20	23-Dec-15	22-Jan-16
P1070	EPC Contract - Prep Bid Package	20	15-Jan-16	12-Feb-16
P1080	EPC Contract - Bid Period	60	12-Feb-16	06-May-16
P1090	EPC Contract - Bid Eval & Recommend	30	06-May-16	20-Jun-16
P1100	EPC Contract - Negotiate	30	20-Jun-16	02-Aug-16
P1290	EPC Contract - Award	0		02-Aug-16
Engineering and Equipment Procure				
P1160	EPC Contract - Procure & Deliver Equipment and Materials	330	16-Aug-16	05-Dec-17
E1000	EPC Contract - Prepare Architectural Drawings	80	26-Oct-16	21-Feb-17
E1010	EPC Contract - Prepare Civil & Structural Drawings	90	26-Oct-16	07-Mar-17
E1020	EPC Contract - Prepare Mechanical Drawings	100	23-Nov-16	18-Apr-17
E1030	EPC Contract - Prepare Electrical & Control Drawings	120	23-Dec-16	14-Jun-17
EPC Construction				
C1030	EPC Contract - Mobilization	20	05-Jul-17	01-Aug-17
C1040	EPC Contract - Construction Installation	255	02-Aug-17	02-Aug-18
C1120	Final DSP Tie-ins	29	01-Jun-18	30-Jun-18
Startup & Commissioning				
S1000	Startup & Commissioning	64	02-Jul-18	01-Oct-18
Project Closeout				
PC1000	Project Closeout	50	02-Oct-18	12-Dec-18
PC1010	As-Built Form to Capital Asset	0		12-Dec-18
PC1020	As-Built Drawings Complete	0		12-Dec-18

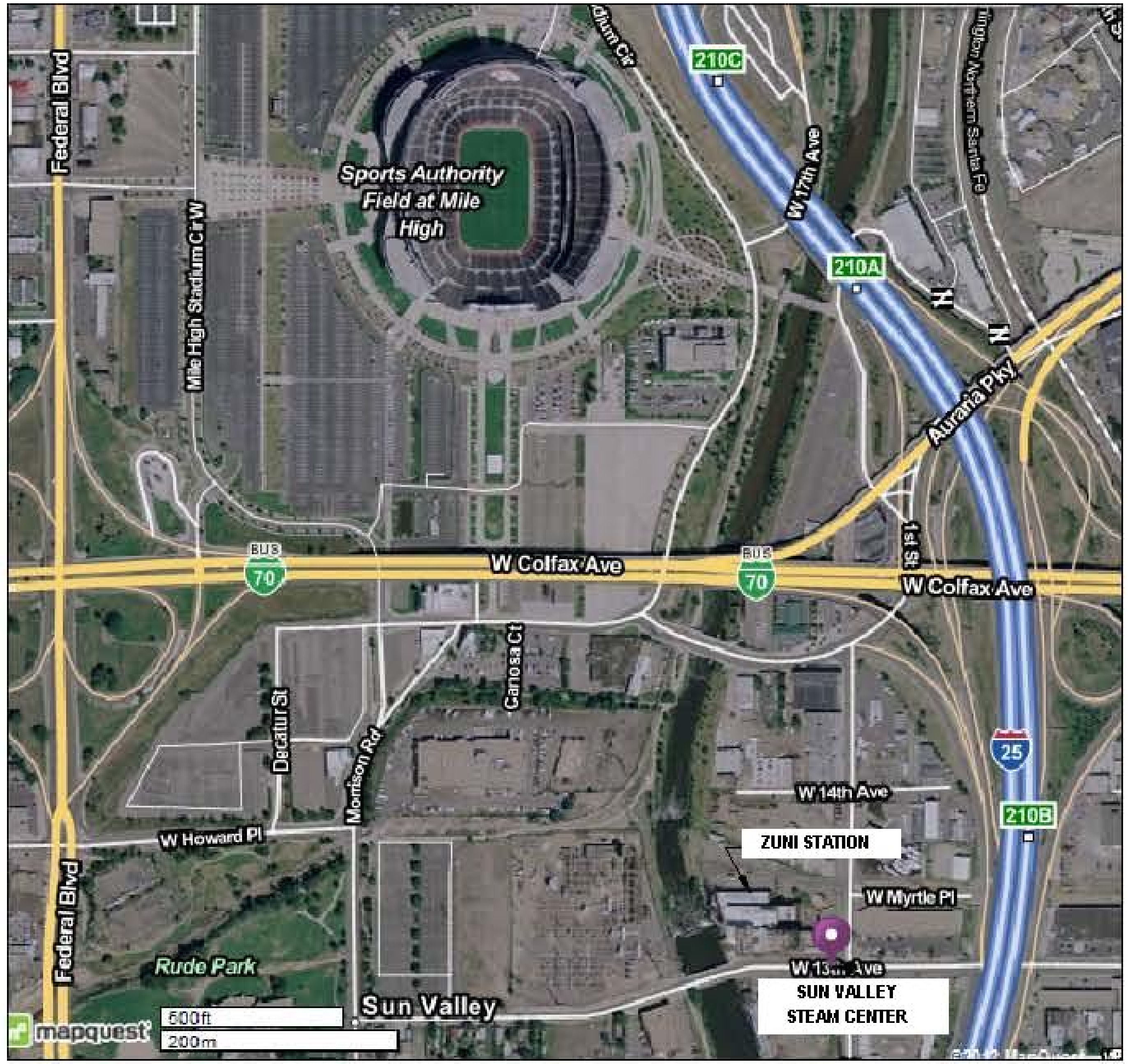


Actual Work | Critical Remaining Work | Critical Milestone
Remaining Work | Milestone | Completed Milestone

Denver Steam Plant Boiler 3
Preliminary Schedule

Date	Revision	Checked	Approved
25-Nov-14	Rev 4		


Zuni Unit 1A
Zuni Unit 2
PROPOSED SUN VALLEY
STEAM CENTER PLANT
(not to scale)
W 13th Ave
Zuni St
Zuni St
Zuni St
100 feet
25 m



NO	REVISION	DATE	BY	CHK	ENG

Xcel Energy®
PUBLIC SERVICE COMPANY OF COLORADO

DWN:	DATE:	CHK:	DATE:
ENG:	DATE:	CHK:	DATE:
PM:	DATE:	PROJ. NO:	
APVD:	DATE:	SCALE:	

SUN VALLEY STEAM CENTER
AERIAL PHOTO

ENERGY SUPPLY
ENGINEERING & CONSTRUCTION

REFERENCE DRAWINGS

DWG NO.	MANUFACTURER	DRAWING TITLE
000000	MANUFACTURER	REF DWG TITLE, LINE 1

NORTHWEST PERSPECTIVE

NORTHEAST PERSPECTIVE

SOUTHEAST PERSPECTIVE

SOUTHWEST PERSPECTIVE

NO	REVISION	ZONE	DATE	BY	CHK	ENG

Burns & McDonnell SINCE 1898

SUN VALLEY STEAM CENTER

BOILER

3D PERSPECTIVES (BASE BID)

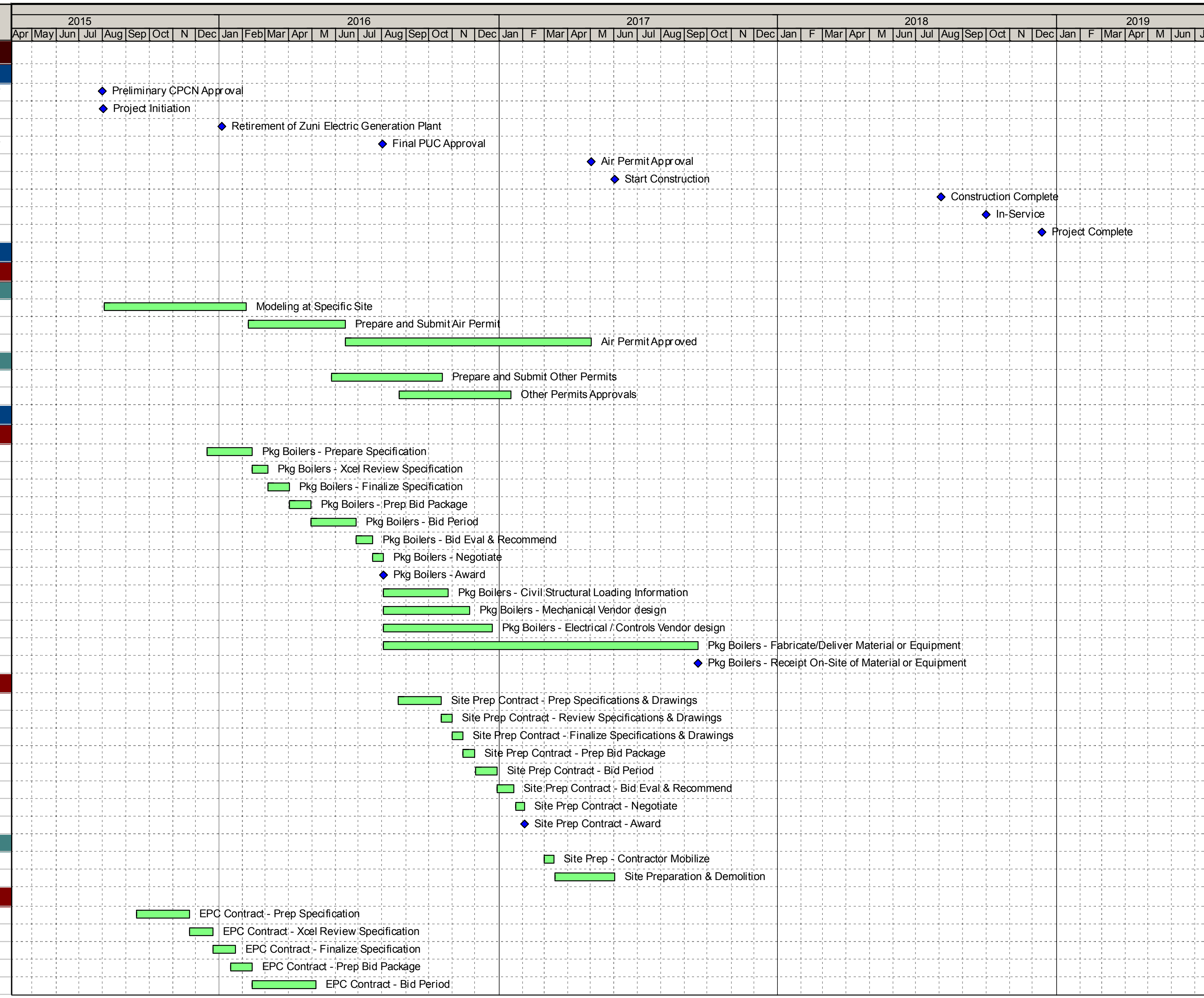
Xcel Energy®
PUBLIC SERVICE COMPANY OF COLORADO

DWN: **APB**	DATE: **01/09/12**	CHK: **RF**	DATE: **01/03/12**	PROJ. NO: 0000000
ENG:	DATE:	CHK:	DATE:	SCALE:
PM:	DATE:	A-700		SHEET REV
APVD:	DATE:			

MF NO


REFERENCE DRAWINGS
DWG NO. | MANUFACTURER | DRAWING TITLE
000000 | MANUFACTURER | REF DWG TITLE, LINE 1
FD FAN VFD
FD FAN VFD
5KV MVSG
5KV MVSG
13.2KV MVSG
LVSG
FWP VFD
FWP VFD
FWP VFD
AIR COMPRESSORS
FEED WATER PUMPS
BLR-1
STACK
SAMPLE STATION
MCC A
SALT SOLUTION STORAGE TANK
SALT STORAGE SILO
SOFTENERS
BLOWDOWN SEPARATORS
BLOWDOWN TANKS
ACID STORAGE TANK
ACTIVATED CARBON FILTERS
TREATED WATER PUMPS
DEGASIFIER
TRANSFER PUMPS
BLR-2
STACK
MCC B
FD FAN
FD FAN
CAUSTIC STORAGE TANK
LAYOUT - GROUND LEVEL
SCALE IN FEET
1 CONCEPT DRAWINGS X-X 01-09-12 XXX XXX XXX
0 PRELIMINARY DRAWINGS X-X 12-06-11 XXX XXX XXX
NO REVISION ZONE DATE BY CHK ENG
SUN VALLEY STEAM CENTER
Burns & McDonnell SINCE 1898
BOILER MECHANICAL EQUIPMENT LAYOUT GROUND LEVEL
Xcel Energy
PUBLIC SERVICE COMPANY OF COLORADO
DWN: PTH DATE: 10-25-11 CHK: JWH DATE: 11-28-11 PROJ. NO: 0000000
ENG: JWH DATE: 10-25-11 CHK: TFP DATE: 11-28-11 SCALE: NONE
PM: JGT DATE: 10-25-11
APVD: TFP DATE: 12-02-11
000-000.000
SHEET 1 REV 0

Activity ID	Activity Name	Original Duration	Start	Finish
Sun Valley Steam Center				
Project Milestones				
A1090	Preliminary CPCN Approval	0		01-Aug-15*
A1000	Project Initiation	0	01-Aug-15	
A1050	Retirement of Zuni Electric Generation Plant	0		04-Jan-16*
A1100	Final PUC Approval	0		01-Aug-16*
A1020	Air Permit Approval	0		01-May-17
A1070	Start Construction	0	02-Jun-17	
A1030	Construction Complete	0		02-Aug-18
A1040	In-Service	0		01-Oct-18
PC1030	Project Complete	0		12-Dec-18
Project Development				
Permitting				
Air Quality Permit				
D1010	Modeling at Specific Site	130	03-Aug-15	05-Feb-16
D1120	Prepare and Submit Air Permit	90	08-Feb-16	13-Jun-16
D1020	Air Permit Approved	224	14-Jun-16	01-May-17
Other Permits				
D1130	Prepare and Submit Other Permits	100	27-May-16	18-Oct-16
D1140	Other Permits Approvals	100	23-Aug-16	16-Jan-17
Procurement				
Packaged Boilers Procurement				
P1120	Pkg Boilers - Prepare Specification	40	16-Dec-15	12-Feb-16
P1220	Pkg Boilers - Xcel Review Specification	15	12-Feb-16	04-Mar-16
P1230	Pkg Boilers - Finalize Specification	20	04-Mar-16	01-Apr-16
P1000	Pkg Boilers - Prep Bid Package	20	01-Apr-16	29-Apr-16
P1030	Pkg Boilers - Bid Period	40	29-Apr-16	27-Jun-16
P1040	Pkg Boilers - Bid Eval & Recommend	15	27-Jun-16	19-Jul-16
P1050	Pkg Boilers - Negotiate	10	19-Jul-16	02-Aug-16
P1060	Pkg Boilers - Award	0		02-Aug-16
P1130	Pkg Boilers - Civil Structural Loading Information	60	02-Aug-16	26-Oct-16
P1140	Pkg Boilers - Mechanical Vendor design	80	02-Aug-16	23-Nov-16
P1150	Pkg Boilers - Electrical / Controls Vendor design	100	02-Aug-16	23-Dec-16
P1010	Pkg Boilers - Fabricate/Deliver Material or Equipment	286	02-Aug-16	18-Sep-17
P1020	Pkg Boilers - Receipt On-Site of Material or Equipment	0		18-Sep-17
Site Preparation Contract				
P1170	Site Prep Contract - Prep Specifications & Drawings	40	22-Aug-16*	17-Oct-16
P1260	Site Prep Contract - Review Specifications & Drawings	10	18-Oct-16	31-Oct-16
P1270	Site Prep Contract - Finalize Specifications & Drawings	10	01-Nov-16	14-Nov-16
P1180	Site Prep Contract - Prep Bid Package	10	15-Nov-16	30-Nov-16
P1190	Site Prep Contract - Bid Period	20	01-Dec-16	29-Dec-16
P1200	Site Prep Contract - Bid Eval & Recommend	15	30-Dec-16	20-Jan-17
P1210	Site Prep Contract - Negotiate	10	23-Jan-17	03-Feb-17
P1280	Site Prep Contract - Award	0		03-Feb-17
Site Prep Construction				
C1010	Site Prep - Contractor Mobilize	10	01-Mar-17	14-Mar-17
C1020	Site Preparation & Demolition	56	15-Mar-17	01-Jun-17
EPC Contract				
P1110	EPC Contract - Prep Specification	50	14-Sep-15	23-Nov-15
P1240	EPC Contract - Xcel Review Specification	20	23-Nov-15	23-Dec-15
P1250	EPC Contract - Finalize Specification	20	23-Dec-15	22-Jan-16
P1070	EPC Contract - Prep Bid Package	20	15-Jan-16	12-Feb-16
P1080	EPC Contract - Bid Period	60	12-Feb-16	06-May-16

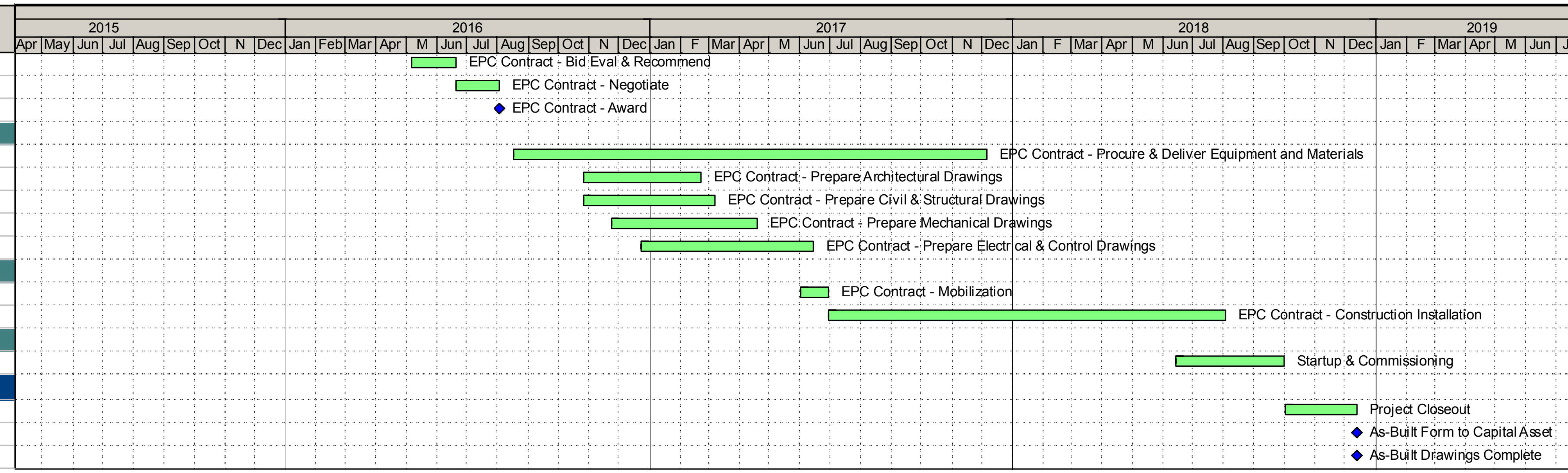


Actual Work — Critical Remaining Work — Critical Milestone
Remaining Work — Milestone — Completed Milestone

Sun Valley Steam Center
Preliminary Schedule

Date	Revision	Checked	Approved
25-Nov-14	Rev 4		

Activity ID	Activity Name	Original Duration	Start	Finish
P1090	EPC Contract - Bid Eval & Recommend	30	06-May-16	20-Jun-16
P1100	EPC Contract - Negotiate	30	20-Jun-16	02-Aug-16
P1290	EPC Contract - Award	0		02-Aug-16
Engineering and Equipment Procure				
P1160	EPC Contract - Procure & Deliver Equipment and Materials	330	16-Aug-16	05-Dec-17
E1000	EPC Contract - Prepare Architectural Drawings	80	26-Oct-16	21-Feb-17
E1010	EPC Contract - Prepare Civil & Structural Drawings	90	26-Oct-16	07-Mar-17
E1020	EPC Contract - Prepare Mechanical Drawings	100	23-Nov-16	18-Apr-17
E1030	EPC Contract - Prepare Electrical & Control Drawings	120	23-Dec-16	14-Jun-17
EPC Construction				
C1030	EPC Contract - Mobilization	20	02-Jun-17	29-Jun-17
C1040	EPC Contract - Construction Installation	277	30-Jun-17	02-Aug-18
Startup & Commissioning				
S1000	Startup & Commissioning	76	14-Jun-18	01-Oct-18
Project Closeout				
PC1000	Project Closeout	50	02-Oct-18	12-Dec-18
PC1010	As-Built Form to Capital Asset	0		12-Dec-18
PC1020	As-Built Drawings Complete	0		12-Dec-18



Actual Work
Critical Remaining Work
Critical Milestone
Remaining Work
Milestone
Completed Milestone

Sun Valley Steam Center
Preliminary Schedule

Date	Revision	Checked	Approved
25-Nov-14	Rev 4		