BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

DOCKET NO. UE-22____

EXH. TCD-2

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REPRESENTING AVISTA CORPORATION

CS2 Single Phase Transformer

EXECUTIVE SUMMARY

Avista has experienced multiple catastrophic GSU transformer failures since the plant's construction in the early 2000's. The purpose of this project is to replace the currently in-service transformer, "T4", which exhibited unacceptably high gassing levels after only being in service a couple of months following the failure of it's twin that failed after approximately nine years of service "T3". Coyote Springs serves Washington and Idaho electric customers. After a detailed financial analysis was performed, the recommended solution is to replace the existing three-phase dual-wound transformer, T4, with three single phase dual-wound transformers. As of the June 2020 (version 3.2) update to this Business Case, the estimated cost is expected to be $21,400,000 which includes replacement of T4 as well as the purchase of a spare unit.

The financial analysis included a calculation of Customer Internal Rate of Return as compared to all possible alternative options. The CIRR of the proposed solution was the highest. Subjectively stated, this project will result in higher reliability and reduced power supply expense. The timeline is critical given the current gassing state of T4. The risk of not approving this business case is the likely failure of T4 with a corresponding outage of 18-24 months.

VERSION HISTORY

Version	Author	Description	Date	Notes
1.0	*Mike Mecham*	*Initial draft of original business case*	*6.25.19*	*Signed/approved*
2.0	*Thomas Dempsey*	*Updated Budget*	*9.19.19*	
3.0	*Thomas Dempsey*	*Updated Budget*	*12.23.19*	
3.1	*Kara Heatherly*	*Conversion to new format*	*6.20.20*	*Includes budget update*
3.2	*Thomas Dempsey*	*Final Updates to new format*	*7/7/2020*	

GENERAL INFORMATION

Requested Spend Amount	$21,400,000
Requested Spend Time Period	2 years
Requesting Organization/Department	GPSS
Business Case Owner | Sponsor	Thomas Dempsey | Andy Vickers
Sponsor Organization/Department	GPSS
Phase	Execution
Category	Project
Driver	Failed Plant & Operations

CS2 Single Phase Transformer

1. BUSINESS PROBLEM

1.1 What is the current or potential problem that is being addressed?

Coyote Springs 2 currently uses a single three phase transformer (GSU) configuration for power transformation to the BPA electric grid. Subsequent initial GSU energization in 2002, we have experienced seven GSU failures. In 2018, a spare transformer (T4) was placed in service subsequent the failure of Transformer 3 (T3). After being in service for one month, T4 saw a spike in combustible gases. Gases are now being closely monitored and the transformer is currently limited to 90% capacity.

The Business Problem is that we now have an underperforming transformer that is not at full capacity and which is exhibiting troubling gassing behavior. We consider the risk of failure to be significantly higher than acceptable. We also have no spare at this time- a failure without a spare could lead to an 18 month or longer outage.

The table below is an overview of the historical failures of the 4 three-phase transformers purchased and installed at Coyote Springs 2 since construction:

	Energized date	Failure Date	Comments
Transformer 1 (Alstom - Turkey)	March, 2002	May, 2002	Catastrophic failure - back feed only
Transformer 2 (Alstom - Turkey)		August, 2002	Failed factory impulse testing Retested and passed, Nov 2002
Transformer 2 (Alstom - Turkey)		December, 2002	Shipping damage to core leg - sent to shop for repair
Transformer 2 (Alstom - Turkey)	May, 2003	Jan, 2004	Buchholz alarm, de-energized. Repaired at factory
Transformer 2 (Alstom - Turkey)	August, 2004	March, 2007	Buchholz alarm, de-energized.
Transformer 3 (Siemens - Brazil)	May, 2007	September, 2018	Buchholz alarm - removed from service
Transformer 4 (Siemens - Brazil)	October, 2018	November, 2018	Spike in combustible gas - still in service

1.2 Discuss the major drivers of the business case and the benefits to the customer

Failed Plant Conditions: one of the primary drivers to our selection of this preferred alternative is the likelihood of the risk exposure that remains with an “in kind” three-phase replacement. It is in Avista’s best interested to spend these resources on a more reliable solution.

1.3 Identify why this work is needed now and what risks there are if not approved or is deferred

This work is needed immediately given the condition of the existing transformer and the lack of a reliable spare. If the existing transformer fails now we would expect to see an 18-24 month outage with its associated power supply expense implications. See business problem details in Section 1.1 and additional data and analysis details provided in Section 2.1.

1.4 Identify any measures that can be used to determine whether the investment would successfully deliver on the objectives and address the need listed above.

- **Power Output**- After the project is complete, the operating limit of the plant will be increased to 320 MW- This is an immediate increase and an appropriate objective measure.
- **Gassing Levels**- The new transformers will be outfitted with Serveron Gas Monitoring equipment to ensure that we are not experiencing interal hot spots or arcing that could lead to catastrophic failure.
- **Reliabilty**- We expect the new transformers to provide reliable service immediately and into the future, therefore equipment availability is the third such measure that can be used to determine if the investment has met the stated objectives.

1.5 Supplemental Information

1.5.1 Please reference and summarize any studies that support the problem

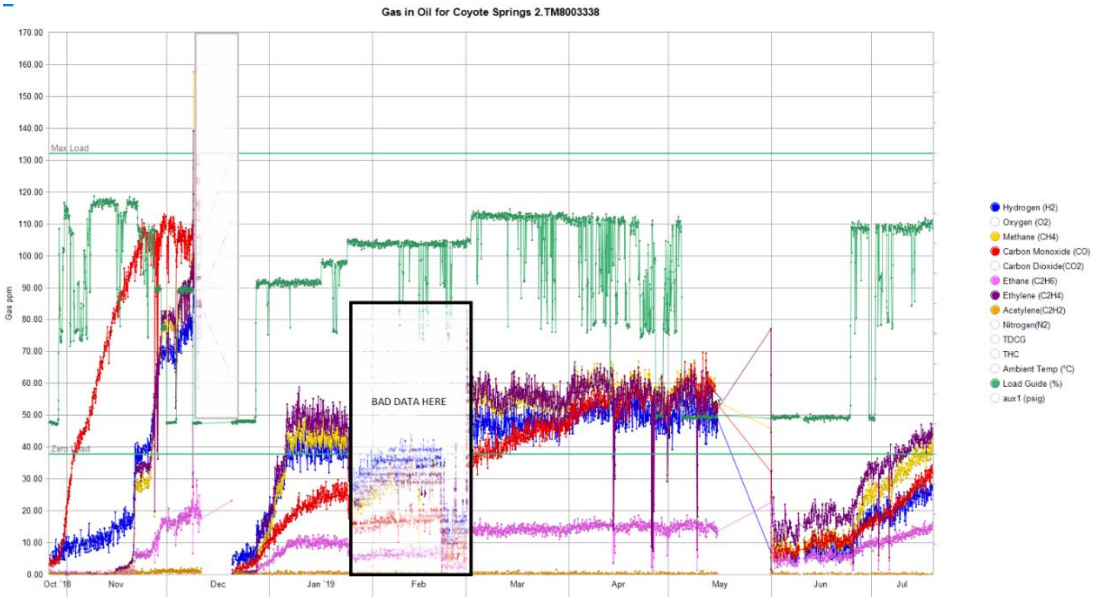
Please see the appendices listed under Section 2.1

1.5.2 For asset replacement, include graphical or narrative representation of metrics associated with the current condition of the asset that is proposed for replacement.

This project provides for replacement of the failed T3 as well as the currently operating but gassing T4. T3 failed catastrophically due to an internal fault. See Figure 1 below that clearly shows internal arcing damage. T4, which is of nearly identical construction as T3, is currently gassing at dangerous levels. If left unchecked, we expect the gasses could reach explosive levels within a two year period. We are carefully monitoring gassing levels to make sure they do not reach these explosive limits during the period of time we are waiting to install the new single phase units. Figure 2 shows the gassing levels currently being seen in T4. In June 2019 we performed a “dialysis” of sorts as a mitigative measure to prevent the dissolved gasses from reaching an explosive level until such time as the transformer can be replaced.

Figure 1- T3 Static Shield Ring Catastrophic Internal Damage

Figure 2- T4 Gassing Trend



1.6 Describe what metrics, data, analysis or information was considered when preparing this capital request.

Avista has experienced multiple failures of GSU transformers in service at Coyote Springs despite proper operations and maintenance activities.

- The new transformers will collectively be higher in capacity than the prior transformers at Coyote to provide a higher safety margin and also to allow for technology improvements (which historically have been typical) that allow for higher output at higher efficiency.

- The three phase transformers have proven to be very expensive and difficult to move due to their size and weight. In an email exchange with BPA where Avista asked about use of three

phase transformers in this application, BPA indicated they would not use transformers of this size due to transportation difficulty.

- Changing to a single phase design versus keeping the existing three phase configuration will be challenging- but given the large number of failures Avista believes it is prudent to abandon the existing configuration. To that end, the financial analysis assumptions regarding three phase transformer reliability reflect Avista's experience at Coyote Springs 2.

- The difficulty and enormous complexity of mobilization associated with the three phase solution results in longer duration outages than those associated with individual single phase transformers.

- Avista and its expert consultants determined that manufacturing defects were the likely culprit with respect to the failures of T1 and T2. The failure mechanism for T3 is currently being evaluated. T4 is in service, however it is gassing at dangerous levels. Avista cannot rule out a fundamental application flaw associated with what Siemens and others have described as a somewhat "unusual" configuration. It is possible that this dual low voltage with 500KV high side configuration approach has as yet-to-be determined fundamental flaws. Avista can no longer rule out this possibility given the number of failures we have experienced. PGE, with its single phase transformers is interconnected with the grid at a virtually identical location as unit 2, and they have experienced no failures in 20+ years of operation.

Additional detail and project background can be found in the associate documents:

- Appendix I 20191223 Power Supply Asset Management Consolidated Financial Analysis
- Appendix II David Nichols Engineering Recommendation
- Appendix III Avista-CoyoteSpgs-GSU-Replcmt-Concept-Report_Final_Rpt-w-ATT rev.pdf
- Appendix IV 20191223 Decision Tree Narrative
- Appendix V 20200513 New Financial Analysis of T5 Project.docx

1.7 Discuss how the requested capital cost amount will be spent in the current year (or future years if a multi-year or ongoing initiative). (i.e. what are the expected functions, processes or deliverables that will result from the capital spend?). Include any known or estimated reductions to O&M as a result of this investment.

In accordance with the detailed project schedule, annual projected capital expenditures for remaining scope are as identified in the 5-year CPG budget:

- 2020 - $9,900,000
- 2021 - $11,500,000

With respect to O&M reduction, the primary reduction to customer expense is the reduction in power supply expense. The financial analysis includes such risk modified expenses. The financial analysis is included as Appendix I.

1.8 Outline any business functions and processes that may be impacted (and how) by the business case for it to be successfully implemented.

This project requires internal and external resources for it to be completed successfully.

1.9 Discuss the alternatives that were considered and any tangible risks and mitigation strategies for each alternative.

Note: The following table of results and the associated explanations represent the initial results from the initial study associated with this project. These numbers were based on our best estimates at the time. As we have gotten further into the project, costs have increased due a number of reasons, including increased fire protection requirements and firm bids from suppliers that were higher than initially projected by Avista's Consulting Engineer. The options were subsequently reviewed and Option V remains the best choice for customers. A summary of the new analysis performed may be found in this document: *20200513 New Financial Analysis of T5 Project.docx.*

Option		Capital Cost	NPV of Net Plant Margin	Relative CIRR	Start	Complete
I.	Repair T3, no repair of T4	$6.2 Million	$209.0 Million	4.0%	10/2019	6/2020
II.	Purchase one (1) new 3-phase, no repair of T4	$8.0 Million	$206.5 Million	5.8%	10/2019	12/2020
III.	Purchase one (1) new 3-phase, Repair T3	$13.7 Million	$206.3 Million	5.8%	10/2019	6/2022
IV.	Purchase two (2) new 3-phase units	$13.1 Million	$207.2 Million	6.2%	9/2019	12/2020
V.	***Purchase four (4) single*-phase transformers (*includes* spare)**	**$15.1 Million**	**$213.9 Million**	**9.4%**	**9/2019**	**6/2021**

Options I- Eliminated due to high power supply risk and relatively lower IRR than the preferred option.

Option II- Eliminated due to high power supply risk and relatively lower IRR than the preferred option.

Option III- Eliminated because Option IV provides superior reliability at lower cost and lacks the opportunity for a double redundant emergency spare. This option also has a relatively lower IRR than the preferred option.

Option IV- Siemens-Austria provided an indicative price for two new 3-phase units at a delivered and commissioned at price of about $9.2 million (Option IV). After other site costs, Avista engineering, and other costs are considered, the price estimate is **$13.1 million**. Furthermore, Avista expects that a choice to begin a new procurement process and a path towards a 3-phase solution would cause significant power supply risk for the summer of 2021. These considerations point further towards Option V as the best solution. Option IV eliminated because even though this option provides the potential for a double redundant emergency spare, it still utilizes the 3-phase dual wound design that has proven unreliable at Coyote Springs in this configuration. This option also has a relatively lower IRR than the preferred option.

Option V- Option 5 is the preferred option as it has the highest relative IRR of any of the options. This option uses single phase transformers that are smaller and much easier to transport. This is the same configuration that is used on Unit 1 which have proven highly reliable over time. This option also allows for a double redundant emergency backup using T4 (this would require iso-phase bus reconfiguration and would only be used if single phase lead times dictated the need).

Siemens-Austria and SMIT-Netherlands were the finalists for Option V. David Nichols and Rob Selby from Avista as well as Avista's expert consultant Pierre Feghali visited both factories. While both appeared to be of high quality, Siemens-Austria stood out as a top of class facility with extensive quality control mechanisms in place. It is therefore the factory of choice the transformer supply costs are referenced to.

RECOMMENDATION: Purchase and install four (4) single phase transformers and all supporting equipment (coolers, fans, instrumentation, bushings). Included in the request is all of the design engineering, all equipment modification including containments, fire suppression, electrical protection, isophase bus, and all supporting equipment.

1.10 Include a timeline of when this work will be started and completed. Describe when the investments become used and useful to the customer. spend, and transfers to plant by year.

Project planning and design activities began in 2019. In order to minimize outage activities during critical operations windows, the project execution plan will include a two-phased outage during the Spring/Summer of 2020 and 2021.

The 2020 outage will consist of early civil/structural foundation work for the T5A and C locations and T5A, B, and C containment where possible.

The 2021 outage will include all civil/structural activities that require T4 to be out of service and relocated, as well as all other activities (including but not limited to): placement of new transformers, installation of IsoPhase Bus, new deluge system piping, and High Voltage Bus.

Project is expected to be completed and Coyote Springs Unit 2 back online by the end of June 2021.

1.11 Discuss how the proposed investment aligns with strategic vision, goals, objectives and mission statement of the organization.

Mission: This project safely, responsibility and affordably improves the level of service we provide to our customers. This project does so by:

- Minimizing our exposure to unnecessary breaks in service
- Avoiding inflated power purchase prices and subsequent increased costs to our customers
- Minimizing the risk of potentially catastrophic failure
- Eliminating ongoing operations safety risks, and
- Eliminating unnecessarily escalating operating costs

Strategic Initiatives: 1. Safe and Reliable Infastructure, 2. Responsible Resources.

1.12 Include why the requested amount above is considered a prudent investment, providing or attaching any supporting documentation. In addition, please explain how the investment prudency will be reviewed and re-evaluated throughout the project

A number of alternatives were considered. The recommended course of action represents the highest value of CIRR. See Appendix I and Appendix II.

With respect to investment prudency review; as of version 3.2 of this business case,the project budget was increased to $21.4 million. We conducted a thorough review as well as a new financial analysis to review whether going forward was the best course of action. It was. A complete discussion of this process and its results is provided in Appendix V- *20200513 New Financial Analysis of T5 Project.docx*. A summary table exerpt from that document is provided below:

Options	**Capital Cost $M / Plant Net Market Value $M**	
Options	Original Analysis	Revised Analysis
Option I- Rebuild T3; T4 Spare	6.2/209	Rejected
Option II- New 3Ph, T4 Spare	8/206.5	Rejected
Option III- New 3Ph, Repair T3	13.7/206.3	17.1/202.5
Option IV- Two new 3Ph	13.1/207.2	17.6/202.1
Option V- Single Phase	15.1/213.9	21.4/**206.6**

1.13 Supplemental Information

1.13.1 Identify customers and stakeholders that interface with the business case

There is no customer interface with respect to this project. Key stakeholders include the Avista Power Supply group as well as GPSS.

1.13.2 Identify any related Business Cases

This Business Case represents the new 2020 format and thus it replaces the prior approved Business Case titled, “BCJN_CS2 Single Phase Transformer_signed 201912”.

2.1 Steering Committee or Advisory Group Information

Prior to July 2020, executive level oversight of this project was provided on an as-needed basis by Power Supply Management, GPSS Management, and Energy Resources Executive Leadership. Initial project estimates and project execution frameworks were developed by Avista’s consultant engineer and project manager, Black and Veatch.

A formal Steering Committee has been established as of July 2020 and will meet on a quarterly basis over the next year to review project status.

As of March 2020, this project has been assigned an Avista Project Manager responsible for the management and regular reporting of scope, schedule and budget deviations from the current project execution plan.

2.2 Provide and discuss the governance processes and people that will provide oversight

Executive level scope, schedule, & budget oversight is provided by the Steering Committee on a Quarterly basis. Ongoing senior management is provided by the Manager of Thermal Operations. Day to day project oversight is provided by the assigned Project Manager.

2.3 How will decision-making, prioritization, and change requests be documented and monitored

Project decisions will be made at the PM level where appropriate and escalated to the Mananger of Thermal Operations & Maintenance when and if determined to be necessary by the role definitions above. Regular updates will be provided to management by the PM team as project scope, schedule and budget are defined, and throughout the course of the project execution.

The undersigned acknowledge they have reviewed the CS2 Single Phase Transformer Business Case and agree with the approach it presents. Significant changes to this will be coordinated with and approved by the undersigned or their designated representatives.

Signature:		Date:	7/10/2020
Print Name:	Thomas Dempsey		
Title:	Manager, Thermal Operations		
Role:	Business Case Owner		

Signature:		Date:	7/10/2020
Print Name:	Andy Vickers		
Title:	Director of GPSS		
Role:	Business Case Sponsor		

CS2 Single Phase Transformer

Signature: _____ Date: _____

Print Name: _____

Title: _____

Role: Steering/Advisory Committee Review

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