BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

DOCKET UE-240006

DOCKET UG-240007

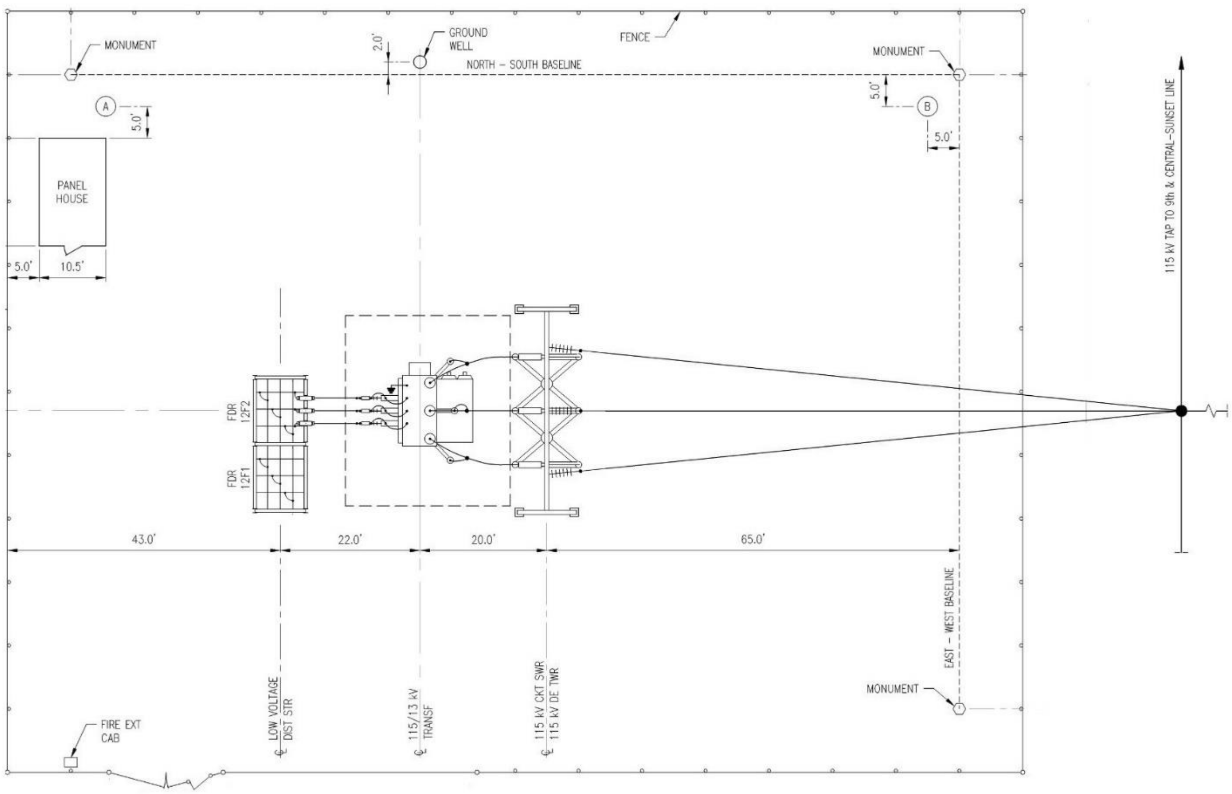
EXH. JDD-8

JOSHUA D. DILUCIANO

REPRESENTING AVISTA CORPORATION

Glenrose Capacity Mitigation

By: Distribution System Planning



System Planning
Avista Utilities
PO Box 3727, MSC-16
Spokane, WA 99220
DistributionPlanning@avistacorp.com

Version	Date	Description	Author	Review
A	2/13/2024	Initial draft for review	K. Hausam	J. Gross
0	5/24/2024	Final	K. Hausam	J. Gross

Table of Contents

1. Project Overview

Customer growth in the South Hill area of Spokane has continued to increase equipment loading in the region. Analysis of Avista's distribution system in south Spokane indicated that a project would need to be completed to mitigate expected system performance issues at the Glenrose Station over the next 10 years. Adjacent stations have recently been upgraded to provide extra capacity for the anticipated growth in the region.

A project was developed to provide stability and capacity at the Glenrose Station.

Per the Technical Analysis, Glenrose Station has multiple elements already at capacity during heavy summer conditions. The project (Glenrose Capacity Mitigation) was developed to mitigate the capacity strain on Glenrose Station, but also positively impacts other substations in the area. Model and data in this report reflects the project work only.

1. Balance phasing loading on GLN12F1 and GLN12F2 feeders
2. Upgrade voltage regulators to 333kVA on GLN12F1 and GLN12F2 feeders.
3. Upgrade to 30MVA transformer in Glenrose Station.

1.1. Problem Statement

Large block load additions on the South Hill of Spokane have increased loading on all feeders in the region and make switching alone a non-solution. More transformation is needed in the area to meet Avista's performance criteria and have operational flexibility. The list below and Table 1 shows existing capacity concerns that the project helps mitigate.

- Capacity limits reached (>80%)
    - Glenrose
        - GLN12F1
        - GLN12F2
        - GLN XFMR #1

Feeder / Sub	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2031	Year 2032	Year 2033	Year 2034
GLN XFMR #1	88.15	88.55	88.96	89.38	89.8	90.22	90.77	91.2	91.62	92.18	92.71
Feeder GLN12F1	91.04	91.38	91.76	92.13	92.52	92.9	93.78	94.17	94.56	94.98	95.37
Feeder GLN12F2	88.84	89.35	89.83	90.31	90.79	91.28	91.77	92.26	93.21	93.71	94.27

Table 1: Expected percent loading of equipment at Glenrose Station

1.1.1. Risks

The risk of not constructing the proposed project by the need by date is the inability to serve customers during peak summer loading conditions. The station is not anticipated to have system performance issues during peak winter loading. Operating procedures are in place to mitigate equipment loading before the equipment reaches 100% of the applicable facility rating. Load transfers to adjacent feeders are utilized to mitigate heavy loading on the equipment in the short term. Large developments currently in construction on the adjacent feeders will limit this transfer capacity. The station transformer can exceed 100% loading temporarily until a major transformer alarm occurs.

1.1.2. Need by Date

Technical studies show equipment ratings may be exceeded during heavy summer conditions. The 80% loading need by date has already been exceeded. 90% loading need by date for Glenrose Station are as follows:

- GLN XFMR #1 - 2029
- GLN12F1 - 2024
- GLN12F2 – 2027

No equipment reaches 100% capacity in the planning period based on stated assumptions in the Technical Analysis.

1.1.3. Technical Prioritization

Avista's Engineering Roundtable compares projects using a scoring matrix which evaluates both the technical importance and urgency of a project. Table 2 provides the suggested scoring for the Engineer Roundtable to use. The technical importance scoring accounts for the inability to server load without experiencing capacity issues and the asset condition considerations of some equipment. The urgency scoring considers the need by date stated in Section 1.1.2.

Serve Load	Capacity	Reliability	System Perfor-mance	Safety	Environ-mental	Regula-tory	Tangential Benefits	Technical Score
0	3	1	1	0	0	0	0	**30**
Date Flexible	**Months Until**	**Budget**	**Transfor-mers**	**Foreign Utility**	**Number of Stations**			**Urgency Score**
0	2	0	0	0	2			**54**

Table 2: Engineering Roundtable prioritization scoring

1.2. Project Scope and Requirements

1.2.1. System Modifications

1.2.1.1. Glenrose Station Design

This project mitigates the identified capacity issues. As indicated earlier in this report, Glenrose station needs additional transformation during heavy summer conditions, and this project includes a new 30 MVA transformer. The existing site, Glenrose Station, can readily accommodate a larger power transformer. The existing 20 MVA transformer at Glenrose Station can be moved to another station requiring a transformer upgrade after the new 30 MVA transformer is installed. The 1000 kCMIL CU conductor connected on the secondary side of the transformer requires upsizing to 2" IPS CU pipe or equivalent with the upgraded 30 MVA transformer. No system performance issues are anticipated during heavy winter conditions.

This project also proposes having GLN12F1 and GLN12F2 voltage regulators upgraded. No distribution build-out is needed to distribute the added transformation capacity. The project diagram provided in Figure 1 summarizes the project scope.

Non-wire alternatives were analyzed in Appendix B – Non-Wire Alternatives, but none were considered feasible for this project.

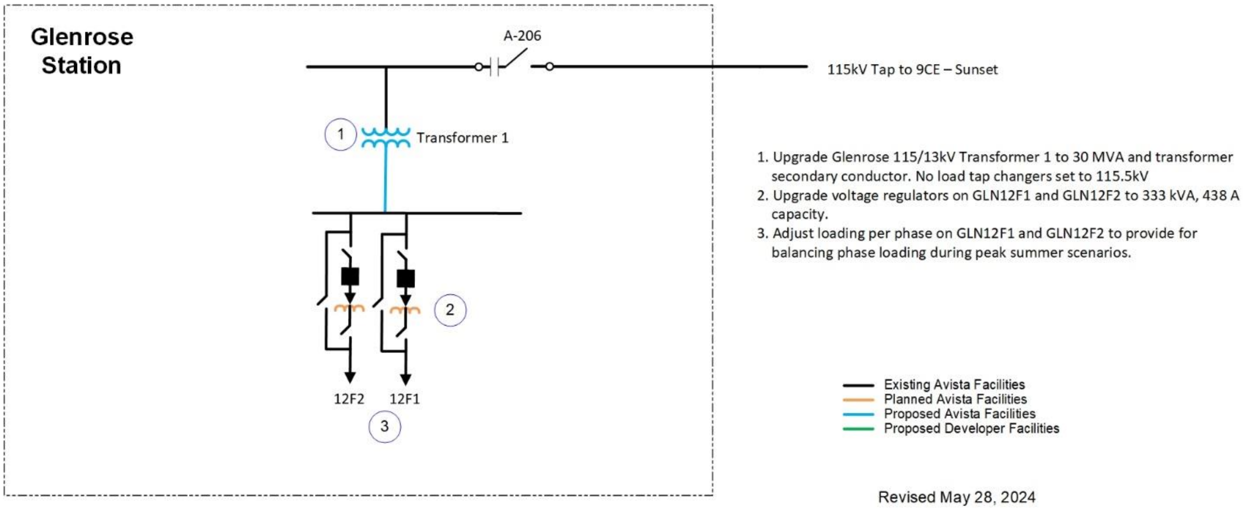


Figure 1: Glenrose Capacity Mitigation project diagram

1.2.1.2. Distribution Integration Design

The following modification to the distribution system is necessary to mitigate the identified performance issues:

- Balance per phase loading on GLN12F1 and GLN12F2 feeders

Both feeders benefit from load balancing in the peak summer case as well as the peak winter case.

Identified potential load balancing areas:

- GLN12F1 - C phase to A phase – Ray St. between 31st Ave and 32nd Ave - Section id 401:12188:0
- GLN12F2 – A phase to C phase – Intersection of Glenrose Rd and 27th Ave Spokane, WA – Section id 389:452699:0

Targeted operational coordination with large load customers such as city water pumps to shift their motor cycling off-peak will help reduce the capacity strain on the existing station. Utilizing load transfers to feeders adjacent to GLN12F1 and GLN12F2 can temporarily alleviate capacity constraints until the station upgrades are complete.

1.2.1.3. Transmission Integration Design

Modification to transmission facilities is not required.

1.2.2. Protection Requirements

Modification to the existing protection scheme is suggested for increased reliability. With installation of a new station transformer, the 50/51T relay and 87T relay should be wired to separate CT's. Currently, the 50/51T and 87T relays are connected to the same set of CT's.

1.2.3. Communication Requirements

Communication aided protection schemes will not be impacted by the project scope. The existing communication circuits at Glenrose Station will provide adequate data communication for the SCADA, DMS, and engineering access. 201 control of the station circuit switcher should be considered for improved system operation.

1.2.4. Metering Requirements

Existing metering points will not be impacted by the project scope.

1.3. Project Execution

1.3.1. Construction Schedule

Preliminary project schedule is as follows:

- Project Scoping - - - - - - Q3 2028
- Physical Design - - - - - - Q4 2028
- Physical Transmittal - - - - - Q4 2028
- Foundations & Grading - - - - Q4 2028
- Electrical Design - - - - - - Q4 2028
- Electrical Transmittal - - - - - Q1 2029
- Electrical Construction - - - - Q1 2029
- Commissioning - - - - - - Q1 2029

Since the project scope is small, this project date can be flexible when there are resources available.

1.3.2. Cost Estimate

The work to be completed under the Glenrose Capacity Mitigation project has budget allocated for Substation, Transmission, Distribution, and Communication work. An estimate of total project cost is roughly $ 2.3 million.

	Total
Substation	$2,300,000
Transmission	$0
Distribution	$0
Communication	$0
Total	**$2,300,000**

Table 3: Project Cost Estimate

1.3.3. Long Lead Time Equipment

Any electric system expansion may be delayed by long-lead time requirements, such as equipment, land acquisition, permitting and/or outage windows. Known schedule constraints that may impact the proposed project schedule are detailed in Table 4.

Potential Constraint	Typical Procurement	Extended Procurement	Impact
Distribution Transformer	12 months	36 months	Yes

Table 4: Long-Lead Time Constraints

1.4. Contingent Facilities

Contingent facilities are unbuilt facilities which, if delayed or not completed, could cause a need for restudying the proposed project.

The following contingent facilities were identified.

ERT #	Project Name	Scope	Targeted Date of Operation	Status
NA	Glenrose Regulator Upgrade	Replace existing GLN12F1 and GLN12F2 regulators with 333kVA regulators.	Q2 2024	Planned

Table 5: Contingent Facilities

2. Technical Analysis

2.1. Assumptions

Only data pertaining to the feeders and substations directly impacted by the selected project solution are listed in this section.

Key Assumptions

- Peak loading at each feeder was extrapolated to the expected demand at an ambient temperature of 40°C (Heavy Summer conditions).
- Relative load at service transformers was assumed to be proportional to the average loading over several days of AMI data recorded during peak summer loading in 2023.
- 5 minute PI data used to build station and adjacent load dataset
    - Peak station load: 8/15/2023 5:50 – 5:55 PM
- Unmasked load from generation (rooftop PV)
- AMI data used to verify loading on feeder laterals.
- Block load additions assumptions as shown in Table 6.
    - 2.6 kVA/Unit, 0.98 pf
    - 1 kVA/unit, 20% of parking for EV chargers
    - 112 kVA/commercial plaza bldg.
    - 64% XFMR utilization if unable to estimate load based on units.

Feeder	Project Name	Energize Year	Total kVA
9CE12F1	Diamond Rock Apartments	2024	2520
9CE12F1	Havana Pumping Station	2024	2245
9CE12F6	Carnahan West Apartments	2024	1019
9CE12F5	4th Ave. Apartments	2024	300
SE12F1	Greenstone Garden District SFR	2024	473
SE12F1	Greenstone Garden District Mixed	2024	640
SE12F3	Radio Tower Apartments	2024	780
SE12F3	Radio Tower Apartments Commercial	2024	1780
SE12F6	ESL Spokane Assisted Living	2024	320
3HT12F5	McKinley Phase 2	2024	1015

Table 6: Customer load additions modeled

Based on Table 7, annual growth rates were applied to the stations impacted by the project work. This growth rate could account for natural adoption of EV's, building electrification and building infill in the planning period since no block load additions can be added to the station due to capacity constraints. Block load additions were used in lieu of growth rates on adjacent stations.

Station	Annual Growth %
Glenrose	0.51

Table 7: Station growth rates

2.2. Base Case Results

The results for the base case are shown in Table 8. This table is contextualized by noting that this is an all-lines in service, 40° C (104° F) (1 year in 10) analysis. Glenrose Substation, specifically, has multiple capacity concerns presently; future load growth and large developments in the area may exacerbate this issue. Figure 2 shows the existing distribution layout for the feeders modeled in this analysis.

Feeder / Sub	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2031	Year 2032	Year 2033	Year 2034
GLN XFMR #1	88.15	88.55	88.96	89.38	89.8	90.22	90.77	91.2	91.62	92.18	92.71
Feeder GLN12F1	91.04	91.38	91.76	92.13	92.52	92.9	93.78	94.17	94.56	94.98	95.37
Feeder GLN12F2	88.84	89.35	89.83	90.31	90.79	91.28	91.77	92.26	93.21	93.71	94.27

Table 8: Base case equipment loading percentage results

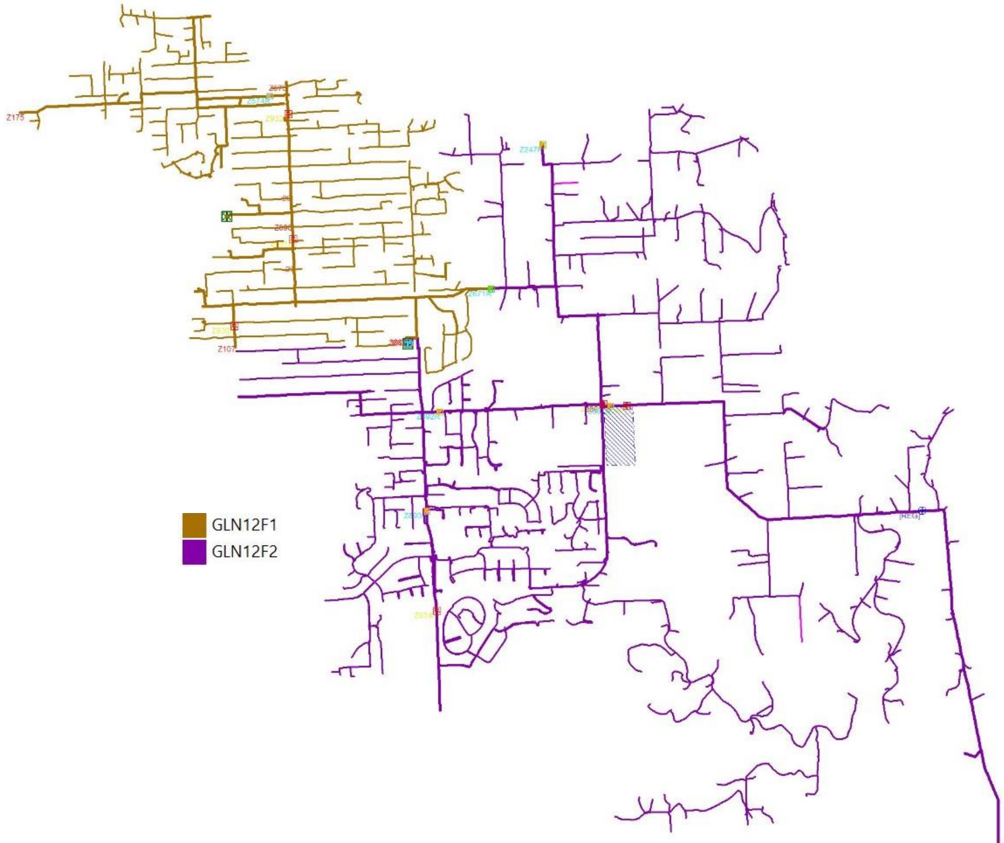


Figure 2: Existing distribution map

Adjacent stations were modeled with coincident loading to Glenrose Station. Known developments with estimated load were also modeled on these adjacent stations shown in Table 9.

	Coincident Loading						Coincident loading with known developments					
	Amps			%Loading			Amps			%Loading		
	A	B	C	A	B	C	A	B	C	A	B	C
3HT - Transformer #1	616	625	571	43	44	40	616	625	571	43	44	40
3HT - Transformer #2	888	906	860	62	63	60	936	953	906	65	66	63
3HT - Transformer #3	649	613	630	45	43	44	649	613	630	45	43	44
3HT12F1	141	130	151	28	25	29	141	130	151	28	25	29
3HT12F2	273	314	245	53	61	48	273	314	245	53	61	48
3HT12F3	201	181	175	39	35	34	201	181	175	39	35	34
3HT12F4	378	403	371	74	79	72	380	403	371	74	79	72
3HT12F5	288	272	274	53	50	50	334	317	321	61	58	59
3HT12F6	223	231	214	43	45	42	222	232	215	43	45	42

3HT12F7	354	316	330	64	57	59	354	316	330	64	57	59
3HT12F8	295	297	301	53	53	54	295	297	301	53	53	54
9CE - Transformer #1	559	572	490	39	40	34	798	791	726	56	55	51
9CE - Transformer #2	671	721	606	47	50	42	717	769	651	50	54	45
9CE12F1	167	179	166	29	31	28	381	394	378	65	67	65
9CE12F2	240	209	145	41	36	25	262	212	167	45	36	29
9CE12F3	153	184	179	26	31	31	155	185	181	26	32	31
9CE12F4	142	152	117	24	26	20	142	153	118	24	26	20
9CE12F5	225	260	266	38	44	45	226	260	266	38	44	45
9CE12F6	305	309	223	52	53	38	349	356	267	60	61	46
SE - Transformer #1	909	895	823	63	62	57	977	962	890	68	67	62
SE - Transformer #2	938	923	1008	65	64	70	1060	1046	1129	74	73	79
SE12F1	354	266	272	69	52	53	404	318	321	79	62	63
SE12F2	280	372	381	47	62	63	282	372	383	47	62	64
SE12F3	324	338	313	63	66	61	442	457	430	86	89	84
SE12F4	346	346	414	58	58	69	349	348	417	58	58	69
SE12F5	268	239	281	52	47	55	269	241	282	53	47	55
SE12F6	275	257	170	46	43	28	291	272	185	48	45	31

Table 9: Adjacent Station Unmasked Loading w/ estimated loading for known developments

2.3. Mitigation Plan Results

This project relieves capacity constraints on Glenrose Station and adds operational flexibility to adjacent feeders. Table 10 shows balancing per phase load on GLN12F1 and GLN12F2, which frees up approximately 5% capacity per feeder. Upgrading of the feeder voltage regulators is shown in Table 11, which alleviates the capacity performance issue on both GLN12F1 and GLN12F2 feeders. The voltage regulator upgraded is expected to be completed by Q2 2024.

Table 12 shows the additional transformation at Glenrose Station, which lowers the system strain and increases capacity. This also gives flexibility to operations by creating capacity for load transfers.

Feeder / Sub	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2031	Year 2032	Year 2033	Year 2034
GLN XFMR #1	87.95	88.38	88.79	89.21	89.63	90.05	90.6	91.02	91.45	92.01	92.67
Feeder GLN12F1	85.99	86.32	86.66	86.99	87.32	87.66	88	88.34	88.68	89.53	89.84
Feeder GLN12F2	81.66	82.1	82.54	82.99	83.44	83.89	84.77	85.23	85.69	86.17	86.6

Table 10: Load balancing loading percentage results

Feeder / Sub	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2031	Year 2032	Year 2033	Year 2034
GLN XFMR #1	87.95	88.38	88.79	89.21	89.63	90.05	90.6	91.02	91.45	92.01	92.67
Feeder GLN12F1	66.01	66.26	66.52	66.77	67.03	67.29	67.55	67.81	68.07	68.72	68.96
Feeder GLN12F2	62.68	63.02	63.36	63.7	64.05	64.39	65.07	65.42	65.77	66.15	66.48

Table 11: Regulator Upgrade loading percentage results

Feeder / Sub	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2031	Year 2032	Year 2033	Year 2034
GLN XFMR #1	57.85	58.16	58.43	58.87	59.14	59.43	59.71	59.99	60.27	60.55	60.84
Feeder GLN12F1	65.2	65.47	65.72	65.95	66.2	66.45	66.71	66.96	67.22	67.48	67.74
Feeder GLN12F2	61.91	62.25	62.58	62.89	63.26	63.6	63.94	64.29	64.63	64.98	65.33

Table 12: XFMR #1 Upgrade loading percentage results

2.4. Short Circuit Analysis

Short circuit analysis was performed for this project. Base case fault current and Thevenin impedance are shown in Table 13. Expected fault current and Thevenin impedance are shown in Table 14.

Location	Three Phase Fault	Single Line to Ground	Thevenin Z1	Thevenin Z0
115 kV Bus	16870 A	11121 A	0.62 + j3.89	1.86 + j9.87
13 kV Bus	5180 A	5246 A	0.05+ j1.47	0.0.04 + j1.42

Table 13: Base case available fault current and Thevenin impedance

Location	Three Phase Fault	Single Line to Ground	Thevenin Z1	Thevenin Z0
115 kV Bus	16870 A	11121 A	0.62 + j3.89	1.86 + j9.87
13 kV Bus	6895 A	7013 A	0.04+ j1.10	0.0.03 + j1.05

Table 14: Mitigation Case available fault current and Thevenin impedance

Fault duty of circuit switcher in the station is sufficient at 20 kA. Asset condition of the circuit switcher should be considered during project scoping.

2.5. Redlined SCADA Variable Limits

Preliminary SCADA Variable Limits are prepared with the intent of identifying constraints along modified or new equipment.

2.5.1. Feeders

The new feeders at Glenrose Station are expected to have a minimum 600A rating at 40°C ambient temperature.

						AMBIENT TEMPERATURE (C)						
				-30	-20	-10	0	10	20	30	40	50
LOCATION	**DEVICE**	**TYPE**	**RATING (Amps.)**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**
SECONDARY SIDE XFMR	5% VOLT. REG.	333 kVA	668	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**667**	**549**
	-------(7.5%)	*MAX CURRENT =*	*526*	*668*	*668*	*668*	*668*	*668*	*648*	*589*	*500*	*412*
	-------(10%)	*668*	*438*	*638*	*638*	*638*	*638*	*589*	*540*	*491*	*417*	*343*
DISTRIBUTION LINE		795 AAC "Arbutus" (75°C)		1303	1232	1158	1079	999	910	810	694	552
SYSTEM CURRENT LIMIT FOR SPECIFIC TEMPERATURE				**668**	**668**	**668**	**668**	**668**	**668**	**668**	**667**	**549**

Table 15: Glenrose 13kV Feeder proposed SVL

2.5.2. Transformers

The new transformer at Glenrose Station is expected to have a minimum 32 MVA (30MVA nominal) at 40°C ambient temperature.

						AMBIENT TEMPERATURE (C)						
				-30	-20	-10	0	10	20	30	40	50
LOCATION	**DEVICE**	**TYPE**	**RATING (Amps.)**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**	**AMPS**
SECONDARY SIDE XFMR	CONDUCTOR	2" IPS CU PIPE (85°C)		2968	2818	2656	2477	2279	2055	1794	1477	**1054**
(55/65°C)	XFMR	ABB ONAN/ONAF/ONAF	1406	**1841**	**1841**	**1841**	**1841**	**1757**	**1673**	**1560**	**1434**	1279
	33,600,000	13,800										
SYSTEM CURRENT LIMIT FOR SPECIFIC TEMPERATURE				**1841**	**1841**	**1841**	**1841**	**1757**	**1673**	**1560**	**1434**	**1054**

Table 16: Glenrose 115/13kV Transformer #1 proposed SVL

3. Conclusion

Large loads are being requested in the South Hill area of Spokane and capacity is already a concern at Glenrose Station. The proposed project resolves the identified system performance violations and adds operational flexibility to the area.

4. Stakeholder Acknowledgement

The Avista stakeholders listed in Table 17 have acknowledged they were informed and consulted during the development of the proposed project.

Function	Name	Date
Substation Engineering	Adam Newhouse	3/14/23
Transmission Engineering		
Distribution Engineering	Caitlin Greeney	4/10/23

Protection Engineering	Kevin Damron	2/13/23
Project Delivery	Katie Prugh	5/13/23
SCADA/EMS		
Transmission Operations	Rich Hydzik	2/13/23
Distribution Operations		
Network Engineering		

Table 17: Avista stakeholder acknowledgement

5. Appendix

5.1. Appendix A – Glenrose Station Offload Study

The Glenrose Station offload study is to assess offloading Glenrose Station to adjacent stations for construction of the project Glenrose Capacity Mitigation. Station loading from 2023 spring (March-May) and fall (September-November) shoulder seasons were analyzed. The Glenrose Transformer #1 average loading is lower in the fall season than in spring season. Additionally, Glenrose Station is a summer peaking station. Adjacent stations have capacity during the shoulder seasons to carry the load of Glenrose Station. Glenrose Station was recently offloaded for transmission work in March 2024 per SPD 24-026.

Glenrose Station should be offloaded during the fall shoulder season for construction due to the previously stated reasoning.

Load transfers to offload GLN12F1:
Close switch Z175 – Parallel GLN12F1 and 3HT12F2
Open GLN12F1 VCB – Break Parallel between GLN12F1 and SE12F3

Load transfers to offload GLN12F2:
Close Z387R – Parallel GLN12F2 and SE12F6
Open GLN12F2 VCB – Break Parallel between GLN12F2 and SE12F6

5.2. Appendix B – Non-Wire Alternatives

Non-wire alternatives were considered during analysis of the identified performance issues.

BESS was modeled using peak load reduction to assess capital deferral at Glenrose Station. A BESS was modeled at 500 kW per feeder and 1000 kW per feeder to assess the impact of the BESS on the station loading. The BESS marginally reduced station loading during peak loading.

Stepped growth of rooftop PV capacity was modeled to assess the impact of increased DER penetration. Due to station peak loading being August around 6:00 PM, solar irradiance is low during this time. The increased DER generation only marginally masked peak load on the station.

BESS and increased rooftop PV at Glenrose Station does not alleviate capacity constraints compared to the wired solution proposed in this report.

5.3. Appendix C – Station Loading Plots

The following figures show the measured peak loading at Glenrose Station. 5-minute average PI data shown in Table 18 was the starting data used for analysis. Figure 3, Figure 4, and Figure 5 show plots during that peak loading period.

Start	Finish	Temp	12F1. AMPA	12F1. AMPB	12F1. AMPC	12F2. AMPA	12F2. AMPB	12F2. AMPC	XFMR.1. AMPA	XFMR.1. AMPB	XFMR.1. AMPC
08-15-2023 5:50 PM	08-15-2023 5:55 PM	103.20	367.93	427.43	451.88	444.82	386.61	368.45	816.33	817.97	824.10

Table 18: Glenrose Station 5m Avg. PI Peak Amps

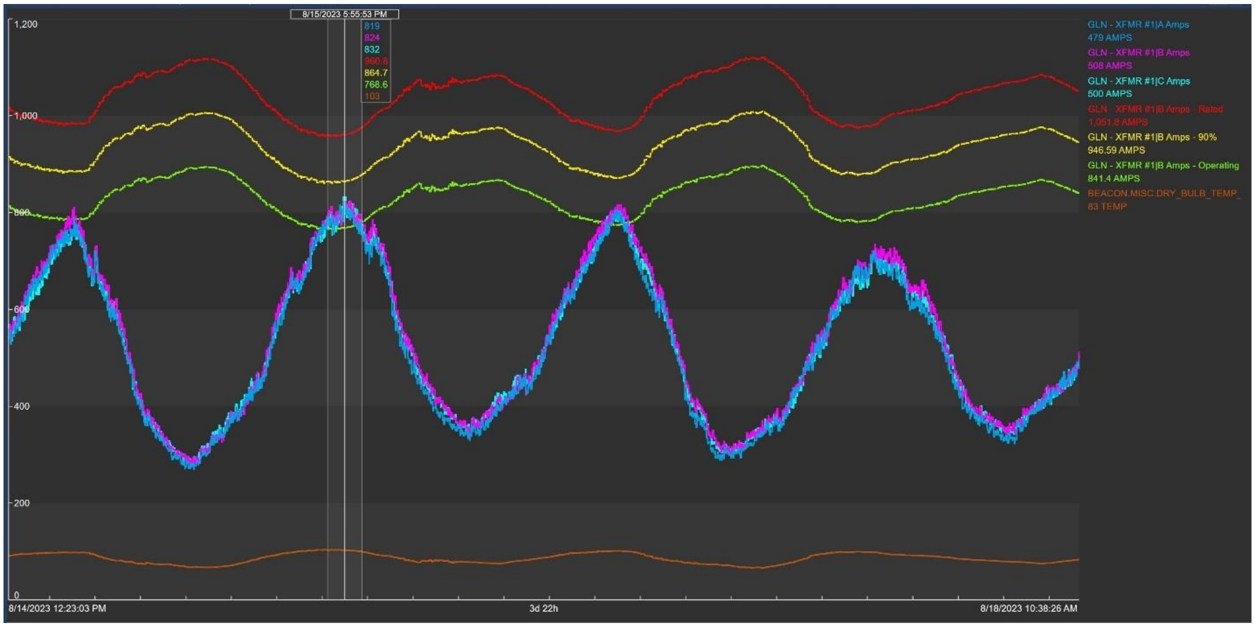


Figure 3: GLN XFMR 1 Peak Loading Plot

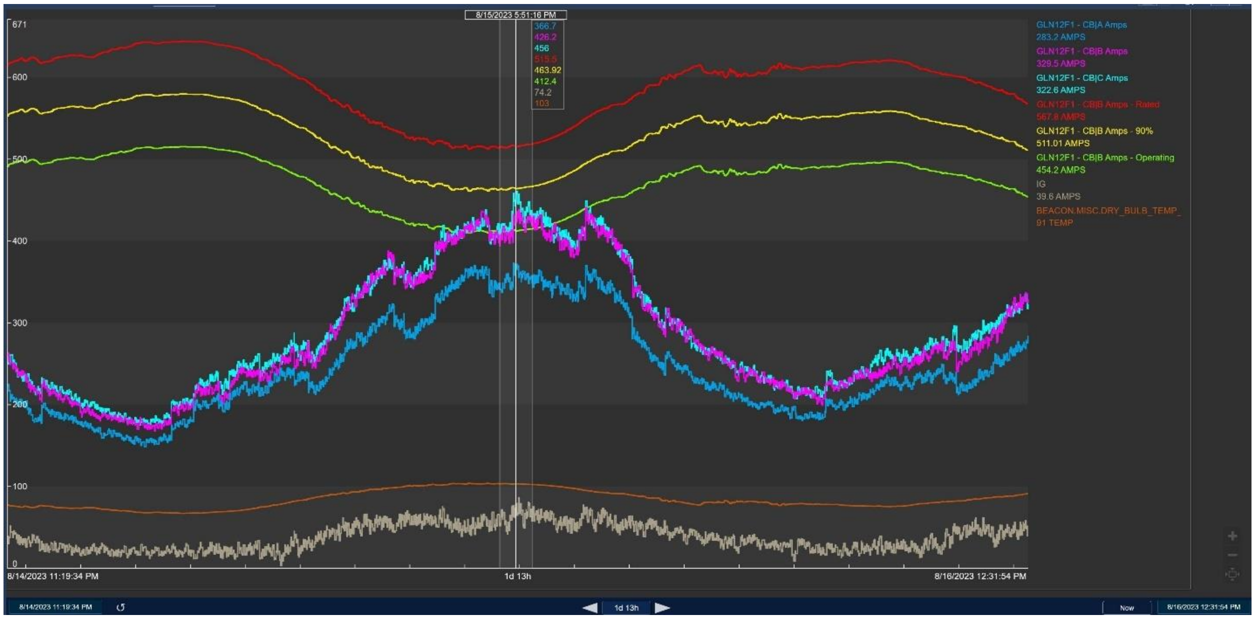


Figure 4: GLN12F1 Peak Loading Plot

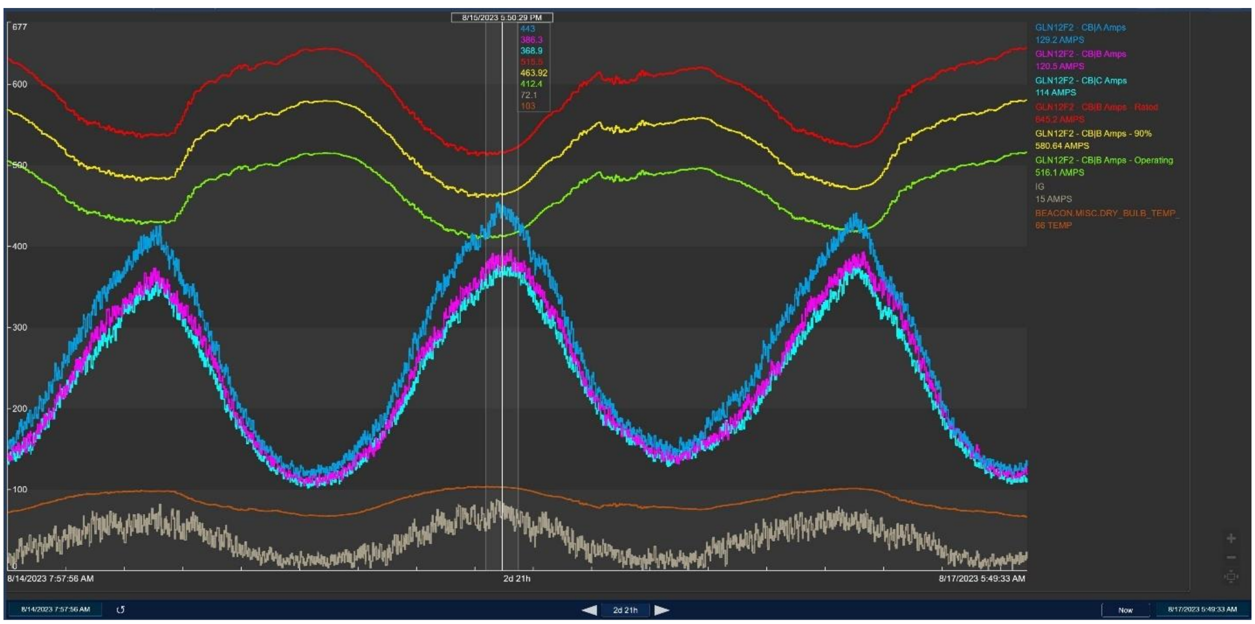


Figure 5: GLN12F2 Peak Loading Plot

The 5-minute peak loading shows masked load. This means that the peak station loading is higher than the measured amp PI values due to generation, rooftop PV in this case. Unmasking load adds this generation at the specified time to the measured load values. Since the peak loading at Glenrose Station was around 6PM, solar irradiance is low at this time and therefore PV generation has a minor effect on true loading values shown in Table 19.

	Amps - A	Amps - B	Amps - C	%Ldg A	%Ldg B	%Ldg C
GLN12F1	371	432	458	72.46%	84.38%	89.45%
GLN12F2	449	391	372	87.70%	76.37%	72.66%

GLN XFMR	820	823	830	85.86%	86.18%	86.91%

Table 19: Unmasked Station Loading

The unmasked load values are temperature aligned to the heavy summer planning temperature of 104° F. The measured loading values have an associated temperature of 103.2° F. Load values are extrapolated using linear regression on historical data. Loading values were adjusted 0.8° F to align with the 104° F planning temperature. Table 20 shows loading values used as the base meter values in the Synergi model.

	Amps - A	Amps - B	Amps - C	% Ldg - A	% Ldg - B	% Ldg - C
GLN12F1	377	441	466	74	86	91
GLN12F2	455	398	380	89	78	74
GLN XFMR #1	832	838	846	87.12	87.75	88.59

Table 20: Temperature-Aligned Station Loading