Load Impact Study

Salt River Project

Resolution Copper Load Impact Study
Project No. 122897

FINAL
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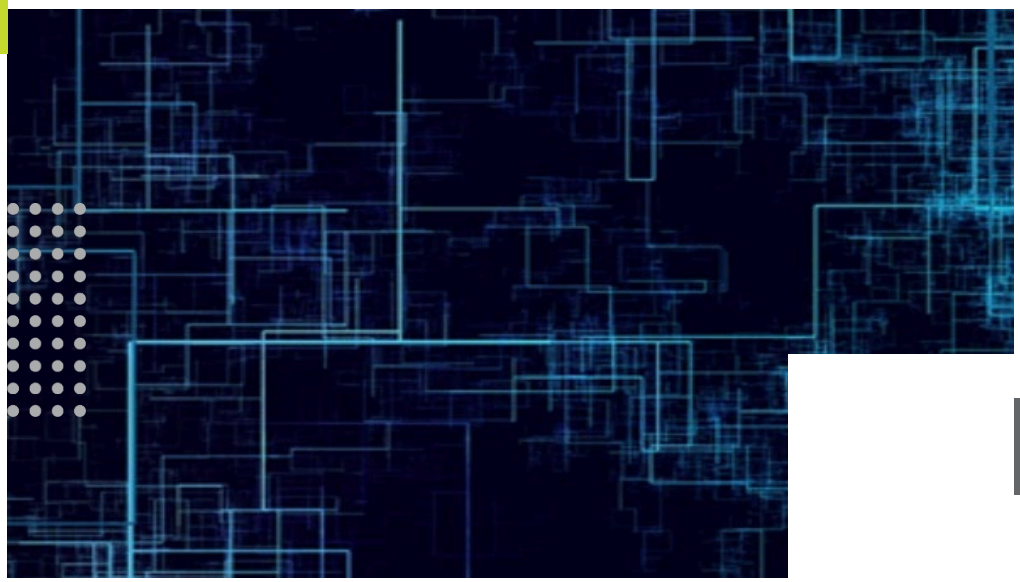

LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
1898 & Co.	1898 & Co., part of Burns & McDonnell
LIS	Load Impact Study
WECC	Western Electricity Coordinating Council
NERC	North American Electric Reliability Corporation
POI	Point of Interconnection

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1.0 EXECUTIVE SUMMARY

Salt River Project Agricultural Improvement and Power District (SRP) retained 1898 & Co. to perform the Load Impact Study (Study) for electric services in support of load increases at the Resolution Copper Mining (RC) facility in Superior, Pinal County, Arizona (Project). The Study includes power flow analysis, transient stability analysis, post-transient analysis, short circuit analysis, and motor start analysis.

The Project plans to increase load levels mainly through the existing West Plant Site (WPS) and East Plant Site (EPS) progressively through construction and into operations of the underground mine and the concentrator. The Project also includes the future Tailings Storage Facility (TSF) 115 kV or 230 kV load, the Booster Pump Station (BPS) 69kV load, which will convey water to the WPS via a future pipeline within the Magma Arizona Railroad (MARRCO) Right of Way, and the Filter Plant (FP) 69 kV load that will be at different locations in approximately 10 years as described in the Resolution Copper Draft Environmental Impact Statement. The Project plans to increase load levels progressively year by year through construction and for the first ten years of operations. The final load levels of the Project are predicted to be as follow:

1) WPS will serve the concentrator and administrative loads totaling 141.5 MW
2) EPS will serve the mining and administrative loads totaling 127.8 MW
3) TSF will serve loads totaling 4.1 MW or 45.7 MW. The current plan involves placement of tailings using high-density thickened/thin lift that requires 4.1 MW, but the study used the conservative assumption of 45.7 MW, which uses filtered tailing.
4) BPS will serve loads totaling 1.9 MW
5) FP will serve loads totaling 9.6 MW

SRP does not project any limitations to serving this load to the Project at the aforementioned sites, presuming the recommended system upgrades are completed. With these system upgrades, SRP does not project any impact on the neighboring customers as the Project site increases loads as per the estimated load levels.

Information on power needs for equipment and facilities for the proposed activities described in the mine plan of operations at the EPS/Underground Mine, WPS, Filter Plant, Tailings Storage Facility and MARRCO booster pump station was provided by Resolution Copper (RC) to SRP for the development of the study cases. A total of four (4) study cases for initiation of construction ramp up and six (6) study cases for initiation of production were developed and evaluated for the impact of the Project load increase. Power flow analysis used all developed study cases and other analyses used selected set of study cases based on the discussion with SRP. Study cases used for each analysis are summarized in Table 1.

SRP operates several hydro units within the Eastern Mining Area. The study evaluated RC under two typical operations scenarios: 1) hydro generating, when nearby hydro units are generating power into the transmission system, and 2) hydro pumping, when the hydro units are drawing power from the transmission system and pumping water back up into the

reservoir for storage. For serving the TSF, two options were evaluated: 1) service from the 115 kV system, and 2) service from the 230 kV system.

Table 1: Study Case Summary

Year	Name	Power Flow	Transient Stability	Motor Start	Post Transient	Short Circuit
Construction Initiation and Ramp-Up	Base Case (Hydro Generating)	X	X		X	X
	Pump Case (Hydro Pumping)	X	X		X	
	Load Case (With RC)	X	X	X	X	X
	Load with Pump Case (With RC & Hydro Pumping – Max Power Draw)	X	X		X	
Initial Production	Base Case (Hydro Generating)	X	X		X	
	Pump Case (Hydro Pumping)	X	X		X	
	TSF Option 1 – 115 kV POI Case (Hydro Generating)	X	X	X	X	X
	TSF Option 2 – 230 kV POI Case (Hydro Generating)	X				
	TSF Option 1 – 115 kV POI with Pump Case (Hydro Pumping)	X	X		X	
	TSF Option 2 – 230 kV POI with Pump Case (Hydro Pumping)	X				

1.1 Power Flow Analysis

A power flow analysis was performed to evaluate the impact of the Project on SRP's transmission system, which must be capable of operating within the applicable normal ratings, emergency ratings, and voltage limits of SRP's transmission planning criteria. The power flow analysis evaluated multiple North American Electric Reliability Corporation (NERC) transmission planning Standard TPL-001-4 P0-P7 contingencies (outage of transmission facilities, such as lines or transformers) to assess thermal loading and voltage exceedances within the study area of SRP. NERC TPL-001-4 establishes transmission system planning performance requirements to ensure the system will operate reliably over a broad spectrum of system conditions and following a wide range of probable contingencies or outages.

The study results showed that there was no new criteria exceedance or pre-existing exceedance in early construction initiation and ramp up scenarios that required system upgrades. For initiation of production, there were a few new criteria exceedances and pre-existing exceedances (worsened by the addition of the Project) that required system upgrades. Recommended system upgrades are summarized in Section 1.6.

The existing 115 kV lines from WPS to EPS have the capacity to maintain normal, emergency rating, and voltage for initiation of construction up to 50 MW under certain outage and operational conditions. Once production is initiated, the existing 230 kV system needs to be expanded to construct new power lines to RC to accommodate the power load growth of RC and surrounding loads.

1.2 Transient Stability Analysis

Transient stability analysis was conducted to assess the performance of the Study area with and without the Project to determine if the transmission system can recover under certain contingencies or outage conditions. Western Electricity Coordinating Council (WECC) Standard TPL-001-WECC-CRT-3 transmission planning criteria was used to assess whether the system met acceptable post contingency requirements based on system voltage recovery and system damping criteria. Thirty-two (25+7) faults near the Point Of Interconnection (POI) of Project were selected for the study.

No damping or voltage exceedance was observed for any of the simulated contingencies in the non-pump mode scenarios. Several contingencies were identified that did not meet acceptable post contingency voltage conditions under pump mode for both initiation of construction ramp up and start of production. Although these conditions are existing issues, the recovery voltage was worsened with the addition of the Project. No system upgrades are recommended, however, because these were existing issues. No additional contingencies (apart from the pre-existing ones) failed the acceptable system conditions.

1.3 Motor Start Analysis

A motor start analysis was performed to assess the impact of the project motor startup due to the initiation of construction and production ramp up for the additional Resolution Copper power needs. The worst-case scenario, based on the starting control mechanism and sequence of equipment and facilities at the EPS (mainly hoisting motors) ramping up simultaneously with the concentrator (Semi-Autogenous grinding mills, ball mills and flotation), tailings pumping and filter plant (as provided by Resolution Copper), was used to simulate the impact of this condition on SRP's transmission system. SRP's transmission bus voltage and frequency, as well as the system's inrush current, were monitored for acceptable starting conditions.

Non-Variable Frequency Drive (VFD) Motors that had 'soft-start' mechanisms were tested to be turned on simultaneously to simulate the worst case scenario. The results showed that the transmission bus voltage was within the transient voltage recovery criteria limit and frequency was damped well. No system upgrade was recommended out of motor start analysis.

1.4 Post-transient Analysis

A post-transient (QV) analysis was performed to determine if adequate Volt-Ampere Reactive (VAR) margin exists in the area before and after the addition of the project. Use of steady state system divergence was used as a criterion for determining adequate reactive support.

There was adequate reactive margin during the initiation of construction scenarios assuming mitigation identified during the power flow analysis are implemented. In the initiation of production ramp up for a multiple facility contingency in the Ray - Superior corridor, there was insufficient reactive margin for when nearby hydro units are operating in pump mode. Further mitigation of dropping localized load or restricting the pump mode is required to ensure adequate reactive margin. No system upgrade was recommended out of post-transient analysis.

1.5 Short Circuit Analysis

Short circuit analysis was conducted to evaluate the fault current levels and the results were compared to the fault interrupt capability at each corresponding breaker.

There was no breaker rating violation or single line-to-ground fault violations in the initial construction ramp up scenario. The fault current levels exceeded breaker ratings for a few breakers in initial production scenarios with the 115 kV TSF interconnect. The fault current level contribution of the project motors at the CL and MOY breakers was 29.8 A and 1.4 A, respectively. The fault current level increase was mainly due to the generation status change and thus the impact of the Resolution Copper project is minimal. No system upgrade was recommended out of short circuit analysis.

1.6 System Upgrade Recommendation

The Study results identified several reliability criteria exceedances especially under the power flow analysis in early/initiation of production scenarios. Power flow analysis in construction ramp up years and initiation of production scenarios did not identify any new criteria exceedance that required system upgrade. The system upgrades are recommended to resolve thermal overloads and voltage exceedances in the power flow analysis in initial production scenarios. Recommended system upgrades are summarized in Table 2.

Table 2: System Upgrade Recommendation Summary

System Configuration	Facility That Showed Exceedance	Exceedance Type	System Upgrade Recommendation
WPS & EPS Existing 115 kV POI	115 kV Lines and Buses in EMA	N-1 / N-1-1 / N-2 Overload and Voltage	New installation of SI - EPS 230 kV Line
			New installation of EPS - WPS 230 kV Line
			New installation of SI - WPS 230 kV Line
			New installation of GF - WPS 230 kV Line
	115 and 230 kV Buses in EMA	N-1-1 Voltage	Additional SI 500/230 kV transformer
	ROS - TS CK1 230 kV Line	N-1 / N-1-1 Overload	
TSF Option 1 Future 230 kV POI	115 and 230 kV Buses in EMA	N-1-1 Voltage	New 420 MVar Cap Banks at EPS 230 kV Station
TSF Option 2 Future 115 kV POI	115 and 230 kV Buses in EMA	N-1-1 Voltage	New 320 MVar Cap Banks at EPS 230 kV Station
			New 170 MVar cap banks at New TSF 115 kV Bus
	MI - PV CK1 115 kV Line	N-1 / N-2 Overload	Reconductor 6.5 mile Section of MI - PV CK1 115 kV Line
	CAA - PV CK1 115 kV Line	N-2 Overload	Upgrade Terminal Equipment (CT)
BPS & FP Future 69 kV POI	None	None	None

SRP's peak demand in 2019 was 7,305 MW. The total maximum combined load proposed by RC is 273 to 315 MW, which represents 3.7 to 4.3% of SRP's 2019 peak demand. SRP is well suited to provide the needed power just as it has done with other large power users across the state.

SRP does not see any limitations to serving this load to the Project at the aforementioned sites, presuming the recommended system upgrades are implemented. With these system upgrades, there will be no impact on the neighboring customers as the Project site increase loads as per the estimated load levels.