Interim Interconnection System Impact Study Report
Request # GI-2008-33
(Power Flow Only)

300 MW Gas Powered Generation Interconnecting at 345 kV Pawnee Substation

PSCo Transmission Planning
March 21, 2012

A. Executive Summary

On December 31, 2008, Public Service Company of Colorado (PSCo) Transmission Planning received a generation interconnection request, GI-2008-33, to determine the potential system impacts associated with interconnecting a 300 MW (270 MW net output) gas-fueled generation facility at the Pawnee Substation through a 3-mile 345 kV transmission line. The 345 kV bus at Pawnee was considered as the Point of Interconnection (POI). The customer requested a commercial operation date for the facility to coincide with the completion of a new 345 kV transmission line between Pawnee and Smoky Hill and the related 345/230 kV substations, which is expected in May 2013. The study request indicated that 1/3 of the generation would be delivered to the Black Hills service area near Pueblo, Colorado, while the remaining 2/3 would be delivered to the Cheyenne area in Wyoming through Western Area Power Administration's (WAPA) transmission network. Generation at Black Hills Pueblo Airport Generation Station will be reduced by 85 MW, and generation at Black Hills Wygen units will be reduced by 185 MW in order to accommodate the requested dispatch of the new generation.

This request was studied as both an Energy Resource (ER)[1] and in a manner similar to a Network Resource (NR)[2] for PSCo's transmission facilities. These investigations included steady-state impact power flow studies and short circuit analysis. The request was studied as a stand-alone project only, with no evaluations made of other potential new generation requests that may exist in the Large Generator Interconnection Request

[1] **Energy Resource Interconnection Service (ER Interconnection Service)** shall mean an Interconnection Service that allows the Interconnection Customer to connect its Generating Facility to the Transmission Provider's Transmission System to be eligible to deliver the Generating Facility's electric output using the existing firm or non-firm capacity of the Transmission Provider's Transmission System on an as available basis. Energy Resource Interconnection Service in and of itself does not convey transmission service.

[2] **Network Resource Interconnection Service** shall mean an Interconnection Service that allows the Interconnection Customer to integrate its Large Generating Facility with the Transmission Provider's Transmission System (1) in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load customers; or (2) in an RTO or ISO with market based congestion management, in the same manner as all other Network Resources. Network Resource Interconnection Service in and of itself does not convey transmission service.

(LGIR) queue, other than the generation projects that are already approved and planned to be in service by the summer of 2013. The main purpose of this study was to evaluate the potential impact of GI-2008-33 on the PSCo transmission infrastructure as well as that of neighboring entities, when interconnecting a total of 300 MW of generation at Pawnee, and dispatching that power to Pueblo, Colorado and Cheyenne, Wyoming as specified above. This study focused on facilities that are part of the PSCo transmission system, while also monitoring other nearby entities' regional transmission systems. Affects on other entities' nearby transmission systems will need to be analyzed by the affected parties.

Three system base case scenarios were created to analyze the impact of the GI-2008-33, 300 MW project, on the existing transmission system. The generation dispatch for these three scenarios was adjusted for the base case without the new project to simulate potential low and high flow levels across the TOT3 transfer path. One scenario also simulated a higher north-to-south value for the TOT7 transfer path flow. Single and common-tower contingencies were applied to each scenario.

With the addition of the GI-2008-33 project at the Pawnee 345 kV substation, the parallel 345/230/13.8 kV transformers at Smoky Hill experienced the most significant thermal violations under single and common tower contingency analysis. These violations occur independently under the removal of one of the transformers from service. Additionally, the Clark to Jordan 230 kV line experienced a thermal violation when the common tower contingency (N-2) of the Smoky Hill to Leetsdale 230 kV circuit and the Smoky Hill to Sullivan 230 kV circuit was taken. No voltage violations resulted due to the addition of GI-2008-33.

Energy Resource (ER)

The results of the power flow from this Interim System Impact Study indicates that firm transmission capacity for the entire 300 MW generation facility **is not available** due to thermal overloads and firm transmission commitments, and is not possible without the construction of network reinforcements. The results of the analysis indicate that approximately **25 MW** of transmission capacity exists for deliveries to Pueblo, Colorado and for deliveries to Cheyenne, Wyoming. Non-firm transmission capability may be available depending on marketing activities, dispatch patterns, generation levels, demand levels, import path levels (TOT3, etc.) and the operational status of transmission facilities.

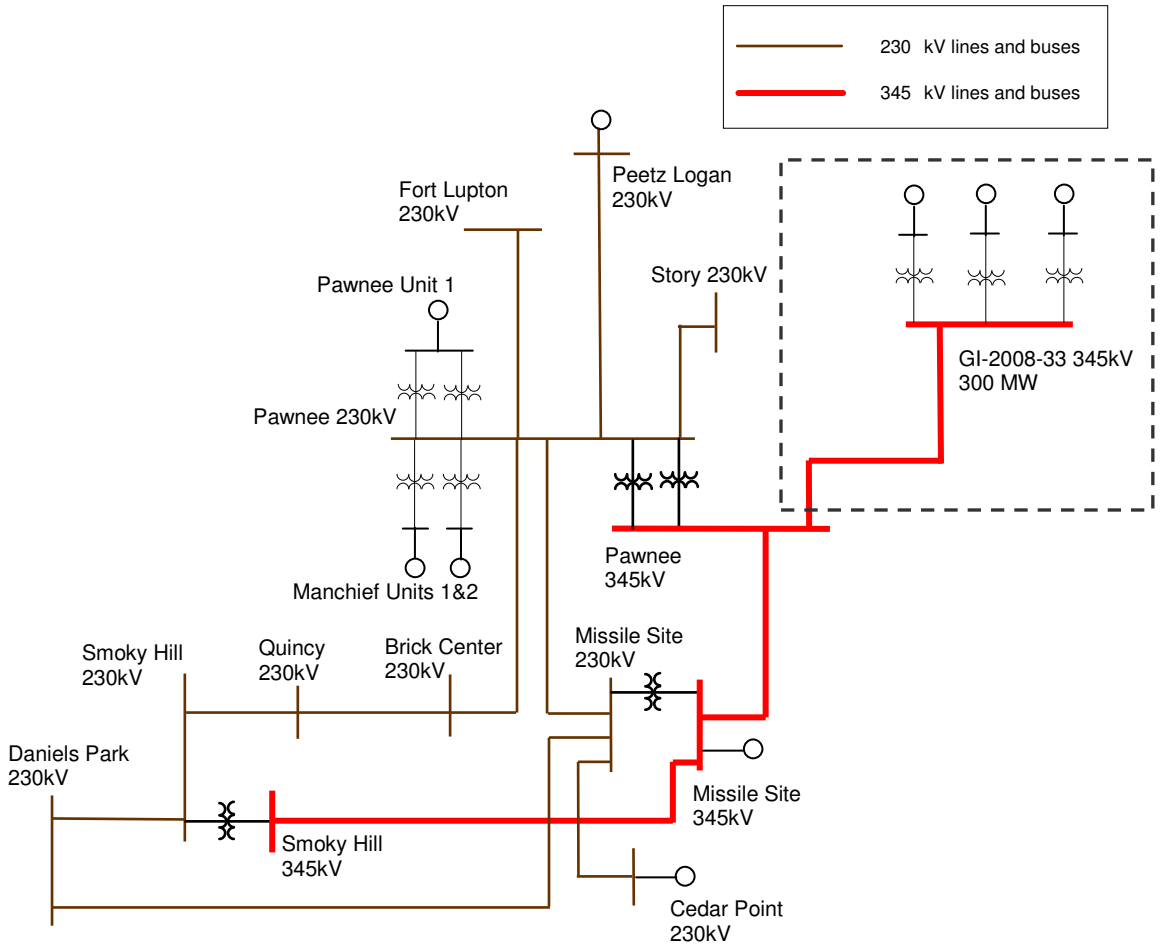
Network Resource (NR)

Network Resource Interconnection Service is an Interconnection Service that allows the Interconnection Customer to integrate its Large Generating Facility with the Transmission Provider's Transmission System in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load customers. A Network Resource is any designated generating resource owned, purchased, or leased by a Network Customer under the Network Integration

Transmission Service Tariff. Network Resources do not include any resource, or any portion thereof, that is committed for sale to third parties or otherwise cannot be called upon to meet the Network Customer's Network Load on a non-interruptible basis. Network Resource Interconnection Service in and of itself does not convey transmission service. The results of the analysis indicate that approximately **22 MW** of transmission capacity exists for deliveries to Pueblo, Colorado and only slightly more for deliveries to Cheyenne, Wyoming. Non-firm transmission capability may be available on an individual day to day basis depending on marketing activities, dispatch patterns, generation levels, demand levels, import path levels (TOT3, etc.) and the operational status of transmission facilities.

Based upon the steady-state analysis performed for this System Impact Study, the applicable portion of the 300 MW generation output of the GI-2008-33 project, 85 MW delivered at the POI, could be provided to PSCo for Pueblo, Colorado after reinforcements to the PSCo transmission system have been completed. These reinforcements are planned to be completed through the PSCo capital budget process for transmission upgrades. Since Cheyenne, Wyoming is not directly connected to PSCo's transmission system and would be dependent on other parties' transmission facilities, no equivalent statement can be made with respect to the remaining 185 MW.

Figure 1 Simple Diagram of the Pawnee Interconnection at 345 kV – 2013



Introduction

Public Service Company of Colorado (PSCo) received a large generator interconnection request (GI-2008-33) to interconnect three (3), GE LMS100 Aero-derivative gas turbine units, rated at 100 MW each, with a total generator nameplate capacity of 300 MW. The net output of the new generation facility is 270 MW. The request indicated a commercial operation and back-feed date to coincide with the completion of the proposed 345 kV upgrades to the Pawnee - Smoky Hill transmission line, currently scheduled for May 31, 2013. The proposed project will be located in Morgan County, Colorado. The project will be connected to the Pawnee Substation with a new 3-mile 345 kV transmission line. As per the customer's request, the 345 kV bus at Pawnee was considered to be the primary Point of Interconnection (POI), and no alternative POI has been considered for this study. This request has been evaluated as a stand-alone project with no other higher queued projects modeled.

The analytical efforts for this request were performed for a total gross generation capacity of 300 MW and consisting of three (3) 100 MW gas turbines, with 30 MW of station service reflected as a load connected to the 345 kV bus. This configuration will also be used for the stability analysis.

The Customer initially requested that this project be evaluated as both an Energy Resource (ER) and a Network Resource (NR), with the generated energy delivered to PSCo for its native load customers. The Customer later changed the intended markets for the power, requesting the energy be delivered to Black Hills Pueblo and Black Hills Wyoming customers.

For this project, potential affected parties include the Platte River Power Authority (PRPA), Western Area Power Administration (WAPA), Tri-State Generation & Transmission (TSGT), and Black Hills Energy (Black Hills). PSCo has forwarded a copy of this interim impact study report to the affected parties.

Power Flow Study Models

The starting power flow case was a 2013 Heavy Summer case that included the new 345-kV facilities between Pawnee and Smoky Hill as well as other committed generation and transmission system changes that are expected to be in operation for the 2013 summer peak period. Since the POI is located at the Pawnee Substation, generation schedules for the major sources of generation in this area were reviewed. These resources included two Missile Site wind projects (a 400 MW facility connected to the 345 kV bus at the Missile Site substation and the Cedar Point 250 MW facility connected to the Missile Site 230 kV bus) and the Peetz Logan 575 MW wind farm.

In this summer peak period analysis with high levels of wind generation reflected in northeastern Colorado, the Pawnee unit was dispatched at 529 MW and the Manchief units 1 and 2 were each set off-line. PSCo control area (Area 70) wind generation

facilities near Pawnee, the Peetz Logan and Cedar Point facilities and the wind project that will be connected to the Missile Site 345 kV bus, were dispatched at approximately 75% of their respective ratings.

For the purpose of this study, the generation in areas 70 (PSCo) and 73 (WAPA) was re-dispatched to simulate north-to-south stress on the transmission system. The TOT3 north-to-south flow was adjusted to two different levels, a high level at 1,348 MW and a low level of 588 MW; these levels represent boundary values for normal flows across TOT3. The TOT7 north-to-south flow was adjusted in a third power flow case to a level of 460 MW coupled with the TOT3 flow of 1,360 MW. These three cases constitute the benchmark cases.

The proposed generation facility, as modeled, consists of three (3) GE 100-MW gas turbines. Each of the turbines have a terminal voltage of 13.8 kV and are connected to the 345 kV system through three (3) identical 13.8/345 kV transformers. For modeling purposes, each of the three generators was set to control the bus voltage on the facility's 345 kV bus to 1.030 per-unit.

The new generation was assumed to displace generation in the Black Hills Pueblo and Black Hills Wyoming systems. Specifically, generation at the Baculite units in Pueblo was reduced by 85 MW, and the total output from the three units at Wygen in northeast Wyoming were reduced by 185 MW. The dispatch levels for PSCo's resources in eastern Colorado and those levels for generators that were adjusted to accommodate the GI-2008-33 facility are shown in Appendix A for the high TOT3 flow base case and the high flow case with GI-2008-33.

A single-line diagram showing the transmission system model with high TOT3 flows during the heavy summer load period in 2013 is presented in Drawing B1 in Appendix B. Drawing B2 in Appendix B indicates the flows with the addition of the GI-2008-33 project dispatched in the manner described above. The impacts of the new generation on select transmission facilities are indicated in Drawing B3. Table 1 below provides a summary of the single-line diagrams for the different power flow cases included in Appendix B for the base case, system intact (N-0) conditions.

Table 1. Base Case Slider Diagrams

High TOT3 Case	Without Project	Drawing B1
	With Project	Drawing B2
	Change Due to Project	Drawing B3
	With Project at 25 MW	Drawing B4
High TOT3 & TOT7 Case	Without Project	Drawing B5
	With Project	Drawing B6
Low TOT3 Case	Without Project	Drawing B7
	With Project	Drawing B8

To demonstrate the level of generation that could be delivered from the facility to the Pawnee 345 kV POI without requiring any system upgrades, an additional power flow case was developed with the gross generation output from GI-2008-33 of 35 MW, and net output of 25 MW. The additional generation was assumed to displace 8 MW of generation at the Baculite units in Pueblo and 17 MW of generation at the three Wygen units in northeastern Wyoming.

Stand Alone Power Flow Results

The results of the AC contingency analyses for the GI-2008-33 addition with the Pawnee 345 kV POI were compared with those from the benchmark cases. For the 2013 case with the proposed generation addition of 300 MW and without any transmission system reinforcements, there are facilities that are adversely impacted by the new generation. Those facilities where facility loading was observed to be adversely impacted are listed in Table 2 below.

Table 2. AC Contingency Analysis for the 2013 HS Case Without Reinforcements

GI-2008-33 Thermal Peak Load Results		HIGH TOT3 flows Scenario				HIGH TOT3 and TOT7 flow Scenario				LOW TOT3 flow Scenario			
		Base Case with Project		Base Case without Project		Base Case with Project		Base Case without Project		Base Case with Project		Base Case without Project	
	TOT3 Flow	1230.5		1348.4		1208		1360.6		478		588	
	TOT7 flow	165.8		223.3		406		460.7		-152		-96.1	
Monitored Element / Contingency	**Branch Rating**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**
70112 CLARK 230 70241 JORDAN 230 1	438.0	483.2	110.3	446.1	101.8								
5167_5285													
70396 SMOKYHIL 345/230 T5 Transformer	560.0	618.3	110.4	555.2	99.1	614.3	109.7	550.8	98.4				
3Wnd: OPEN SMOKYHIL 345/230 T4 Transformer													
70396 SMOKYHIL 345/230 T4 Transformer	560.0	618.3	110.4	555.2	99.1	614.3	109.7	550.8	98.4				
3Wnd: OPEN SMOKYHIL 345/230 T5 Transformer													

Given that PSCo has received the necessary CPCN to construct, and construction efforts are already underway, for the Pawnee – Smoky Hill 345 kV transmission line, it is expected that this 345 kV line along with the necessary 345/230 kV transformers will be operational by the May 2013 timeframe. Under this assumption, one transmission line and both the Smoky Hill 345/230/13.8 kV transformers would be overloaded under the studied contingency conditions when the GI-2008-33 facility is connected to the Pawnee 345 kV bus.

Table 2 shows that, for the full output of GI-2008-33, both the Smoky Hill 345/230 kV transformers are loaded to 110.4% of their 560 MVA rating under a single contingency outage of one of the transformers.

Included in Table 2 is one double contingency (N-2) common-tower outage, 5167_5285. This common-tower outage is described in Table 3 below. The 101.8% contingent loading of the Clark to Jordan 230 kV line, rated at 438 MVA, is increased by 8.5% to 110.3% due to the addition of GI-2008-33.

Table 3. Double Contingency (N-2) Common-Tower Outage Description

Contingency Name 5167_5285
SMOKY HILL to SULLIVAN 230 kV
SMOKY HILL to LEETSDALE 230 kV

The recommended network reinforcement to address the single contingency overloads would be to add a third 345/230 kV, 560 MVA transformer at Smoky Hill. This network upgrade was modeled and a contingency analysis was performed to identify any new violations resulting from this network upgrade. The results of the contingency analysis with the recommended system upgrade indicated the Smoky Hill transformer overloads were resolved; however, violations under the double contingency (N-2), common-tower outage conditions were increased by 1.7%. Results after the addition of the network upgrades are shown in Table 4 below.

Table 4. AC Contingency Analysis for the 2013 Case With Reinforcements

		HIGH TOT3 flows Scenario				HIGH TOT3 and TOT7 flow Scenario				LOW TOT3 flow Scenario			
GI-2008-33 Thermal Peak Load Results with 3rd 345/230/13.8 Smoky Hill Transformer		Base Case with Project		Base Case without Project		Base Case with Project		Base Case without Project		Base Case with Project		Base Case without Project	
TOT3 Flow		1230.5		1348.4		1208		1360.6		478		588	
TOT7 flow		165.8		223.3		406		460.7		-152		-96.1	
Monitored Element / Contingency	**Branch Rating**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**
70112 CLARK 230 70241 JORDAN 230 1	438.0	483.2	110.3	446.1	101.8								
5167_5285													
70283 MEADOWHL 230 70396 SMOKYHIL 230 1	621.0	627.3	101.0	590.1	95.0								
5167_5285													

Energy Resource (ER):

The ER portion of this study indicates that the Customer could provide approximately 25 MW of additional generation to the Pawnee 345 kV POI without requiring the addition of a new 345/230kV transformer at Smokey Hill substation if transmission service is available. Once the interconnection is made at the 345 kV POI, non-firm transmission capability may be available depending upon marketing activities, dispatch patterns, generation levels, demand levels, import path flow levels (TOT3, etc.), and the operational status of the transmission facilities. Appendix B, Drawing B4 shows the loading on the system with 25 MW delivered to the Pawnee POI. Table 5 below shows the system overloads at this same level.

Table 5. Contingency Analysis for the 2013 Case With Project Delivering 25 MW

GI-2008-33 Thermal Peak Load Results for Energy Resource	HIGH TOT3 Flow Scenario with GI-2008-33 Delivering 25MW Output Distributed as Requested			
	Base Case with Project		Base Case without Project	
Monitored Element / Contingency	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**
70396 SMOKYHIL 345/230 T5 Transformer	561.0	100.2	555.2	99.1
3Wnd: OPEN SMKYHL T4 Transformer				
70396 SMOKYHIL 345/230 T4 Transformer	561.0	100.2	555.2	99.1
3Wnd: OPEN SMKYHL T5 Transformer				

Network Resource (NR):

The results of this study indicate that the 300 MW GI-2008-33 generation project delivered to the Pawnee POI would result in the overloading of facilities in the PSCo regional transmission system. Therefore, the 300 MW NR value requested will require Interconnection and Transmission Network Upgrades. After these upgrades are complete, 300 MW (gross) of the new generating facility could be considered a network resource with firm transmission capability for that portion of the output of the plant to be delivered to Pueblo area load. Until the system upgrades are complete, only 22 MW could be delivered to PSCo's system at the Pawnee 345 kV POI if transmission service is available as shown in Table 6 below. With the transmission system reinforcements in place and operating guides established as needed, the injection of a net 270 MW at the POI will not cause any overloads on the PSCO system under the conditions studied.

Table 6. Contingency Analysis for the 2013 Case With Project Delivering 22 MW

GI-2008-33 Thermal Peak Load Results Network Resource	HIGH TOT3 Flow Scenario with GI-2008-33 Delivering 22MW Output as Network Resource			
	Base Case with Project		Base Case without Project	
Monitored Element / Contingency	**Cont MVA**	**Loading %**	**Cont MVA**	**Loading %**
70396 SMOKYHIL 345/230 T5 Transformer	561.6	100.3	555.2	99.1
3Wnd: OPEN SMKYHL T4 Transformer				
70396 SMOKYHIL 345/230 T4 Transformer	561.6	100.3	555.2	99.1
3Wnd: OPEN SMKYHL T5 Transformer				

Voltage Criteria Violations

The results of the steady state contingency analysis did not indicate high or low voltage violations or any voltage deviation criteria violations as a result of the studied contingencies.

Short Circuit Analysis

A short circuit breaker duty analysis was conducted to determine if the available fault current (single-line-to ground or three-phase) exceeds the interrupt ratings of any circuit breakers at the Pawnee Substation. The fault study compared the available fault current at the Pawnee Substation before and after the addition of the proposed new generation injected at the POI. Table 7 below summarizes the results of the short circuit analysis.

Table 7. Short-circuit Study Results With and Without the Proposed 200 MW Wind Farm

System Condition	Three-phase (amps)	Thevenin System Equivalent Impedance (R,X) (ohms)	Single-line-to-ground (amps)	Thevenin System Equivalent Impedance (R,X) (ohms)
Pawnee 230kV Bus **After** to the Addition of GI-2008-33	I_1=30,425 I_2=I_0=0 I_A=I_B=I_C=30,425	Z1(pos)= 0.28259,4.35540 Z2(neg)= 0.28594,4.36014 Z0(zero)= 0.24555,3.07753	I_1=I_2=11,233 3I_0=33,700 I_A=33,700 I_B=I_C=0	Z1(pos)= 0.28259,4.35540 Z2(neg)= 0.28594,4.36014 Z0(zero)= 0.24555,3.07753
Pawnee 345kV Bus **After** to the Addition of GI-2008-33	I_1=16,578 I_2=I_0=0 I_A=I_B=I_C=16,578	Z1(pos)= 0.64430,11.9977 Z2(neg)= 0.65301,12.0022 Z0(zero)= 0.91236,11.948	I_1=I_2=5585 3I_0=16,756 I_A=16,753 I_B=I_C=0	Z1(pos)= 0.64430,11.9977 Z2(neg)= 0.65301,12.0022 Z0(zero)= 0.91236,11.948

Fault currents at the Pawnee 230 kV and 345 kV busses after the addition of GI-2008-33 are 33,700 amps and 16,756 amps respectively for single-line to ground faults, and 30,425 amps and 16,578 amps respectively for a three-phase fault.

Results of the short circuit analysis show that the fault current levels at the Pawnee 230 kV and 345 kV busses are within the interrupting ratings of the breakers; therefore, the addition of the generation interconnection project and associated infrastructure will not cause fault currents to exceed the circuit breaker ratings.

Cost Estimates and Assumptions

Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by Xcel Energy/PSCo Engineering staff. The cost estimates are in 2012 dollars with escalation and contingencies applied (AFUDC is not included) and are based upon typical construction costs for previously performed similar construction. These estimated costs include all applicable labor and overheads associated with the engineering, design, material/equipment procurement and construction of these new PSCo facilities. This estimate does not include the cost for any other Customer owned equipment and associated design and engineering.

The estimated total cost for the required upgrades for is **$38.96 million.** These estimates do not include costs for any other Customer owned equipment and associated design and engineering. The following tables list the improvements required to accommodate the interconnection and the delivery of the Project generation output. The cost responsibilities associated with these facilities shall be handled as per current FERC guidelines. System improvements are subject to change upon a more detailed and refined design.

Table 8. PSCo Owned; Customer Funded Transmission Provider Interconnection Facilities

Element	Description	Cost Est. (Millions)
PSCo's Pawnee 345kV Transmission Substation	Interconnect Customer to the 345kV bus at the Pawnee Substation. The new equipment includes: • One 345kV, 3000 amp gang switch • Three 345kV metering CT's • Three 345kV metering CCVT's • Three 345kV lightning arresters • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated transmission line communications, fiber, relaying and testing.	**$1.78**
	Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities	**$1.78**
Time Frame	**Design, procure and construct**	**10 Months**

Table 9. PSCo Owned; PSCo Funded Interconnection Network Facilities

Element	Description	Cost Estimate (Millions)
PSCo's Pawnee 345kV Transmission Substation	Interconnect Customer to the 345kV bus at the Pawnee Substation. The new equipment includes: • One 345kV, 3000 amp circuit breaker • Two 345kV, 3000 amp gang switches • Associated station controls, communications, supervisory and SCADA equipment • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated equipment and system testing	**$0.63**
	Total Cost Estimate for PSCo-Owned, PSCo-Funded Interconnection Facilities	**$0.63**
Time Frame	**Design, procure and construct**	**10 months**

Table 10. PSCo Network Upgrades for Delivery

Element	Description	Cost Est. (Millions)
Harvest Mile 345/230kV Transmission Substation	Construct the new Harvest Mile 345/230kV Transmission Substation to include the following: • New land acquisition & land use permits • New 345/230kV substation with five (5) 345kV circuit breakers designed in a ring bus configuration • Two 345kV line terminals, one to Missile Site Substation and one to Smoky Hill Substation • One 345/230kV, 560 MVA autotransformer • One 230kV circuit breaker installed in the new 230kV substation yard with a line termination to Smoky Hill 230kV Substation • Transmission line construction to sectionalize the 345kV Missile Site to Smoky Hill line • Associated switches, bus work, site improvements, system protection equipment, Electric Equipment Enclosure, etc.	**$31.84**
Smoky Hill 230kV Substation	Develop one new 230kV line termination at Smoky Hill	**$2.83**
New 230kV Trans. Line / Harvest Mile to Smoky Hill	Construct new 230kV transmission line between Harvest Mile and Smoky Hill Substations	**$1.88**
	Total Cost Estimate for PSCo Network Upgrades for Delivery	**$36.55**
	Total Project Estimate	**$38.96**
Time Frame	**Obtain Regulatory approval, acquire land, obtain local land use permits, design, procure and construct**	**6 years**

Cost Estimate Assumptions

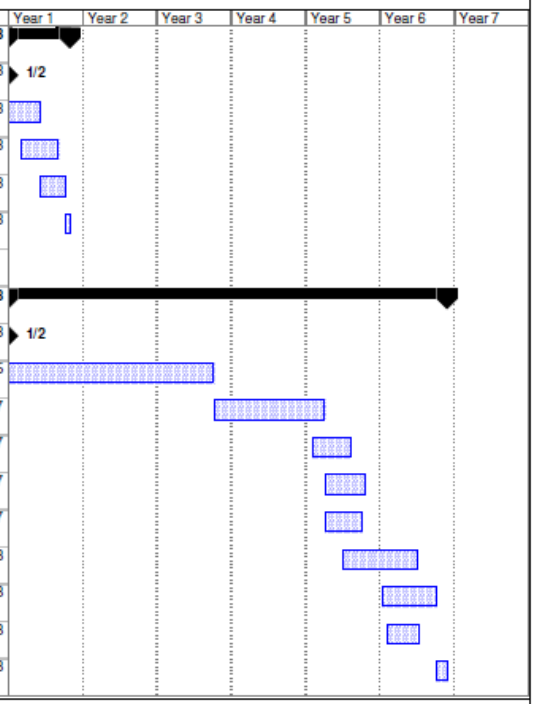
- Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by Xcel Energy/PSCo Engineering staff.
- Estimates are based on 2012 dollars (appropriate contingency and escalation applied).
- AFUDC has been excluded.
- Engineering will be performed in house.
- Lead times for materials were considered for the schedule.
- The Generation Facility is not in PSCo's retail service territory.
- PSCo (or it's Contractor) crews will perform all construction, wiring, testing and commissioning for PSCo owned and maintained facilities.

- Construction labor is estimated for straight time only – no overtime included.
- The estimated time to design, procure and construct the interconnection facilities is approximately 10 months after authorization to proceed has been obtained.
- The estimated time to design, procure and construct the PSCo Network Upgrades for Delivery is approximately 6 years after authorization to proceed has been obtained.
- A CPCN is required for the PSCo Network Upgrades for Delivery.
- Authorization to proceed is considered to be the execution of the LGIA.
- This project is completely independent of other queued projects and their respective ISD's.
- Line and substation bus outages will be authorized during the construction period to meet requested backfeed dates.

Project Schedule

GI-2008-33 System Impact Study
Estimated Project Milestone Schedule
Schedule Assumes a Day One Start on 1/2/2013

ID	Task Name	Duration	Start	Finish
1	**Pawnee 345kV Substation**	**216 days**	**Wed 1/2/13**	**Wed 10/30/13**
2	LGIA Executed - Day One	1 day	Wed 1/2/13	Wed 1/2/13
3	Substation Design & Engineering	22 wks	Thu 1/3/13	Wed 6/5/13
4	Material Procurement	26 wks	Thu 3/7/13	Wed 9/4/13
5	Substation Construction	18 wks	Thu 6/6/13	Wed 10/9/13
6	Final Commissioning & Energization	3 wks	Thu 10/10/13	Wed 10/30/13
7				
8	**Harvest Mile Substation**	**1541 days**	**Wed 1/2/13**	**Wed 11/28/18**
9	LGIA Executed - Day One	1 day	Wed 1/2/13	Wed 1/2/13
10	CPCN Preparation, Filing & Approval	24 mons	Thu 1/3/13	Wed 10/7/15
11	Siting, Local Permitting & Public Outreach	78 wks	Thu 10/8/15	Wed 4/5/17
12	Land Acquisition	26 wks	Thu 2/9/17	Wed 8/9/17
13	Substation Design & Engineering	28 wks	Thu 4/6/17	Wed 10/18/17
14	Transmission Line Design & Engineering	26 wks	Thu 4/6/17	Wed 10/4/17
15	Material Procurement	52 wks	Thu 7/6/17	Wed 7/4/18
16	Substation Construction	38 wks	Thu 1/11/18	Wed 10/3/18
17	Transmission Line Construction	22 wks	Thu 2/8/18	Wed 7/11/18
18	Final Commissioning & Energization	8 wks	Thu 10/4/18	Wed 11/28/18



Project: Project Milestone Schedule 2
Date: Wed 2/29/12

Task | Milestone | External Tasks
Split | Summary | External Milestone
Progress | Project Summary | Deadline

Page 1

Conclusion

The addition of the GI-2008-33 project with the POI at the Pawnee 345 kV substation will have an adverse impact on the loading of the Smoky Hill 345/230/13.8 kV transformers under summer peak conditions. The thermal violations from this analysis indicated that the loss of one of these two parallel 345/230/13.8 kV transformers would result in the loading of 110.4% of the 560 MVA rating for the remaining transformer. Other violations included a double contingency (N-2), common-tower outage that results in a 110.3% loading violation of the Clark to Jordan 230 kV line rated at 438 MVA. The Common-tower outage includes the Smoky Hill to Leetsdale 230 kV line along with the Smoky Hill to Sullivan 230 kV line. The only considered network upgrades was the addition of a third 345/230/13.8 kV transformer at the Smoky Hill substation, which successfully relieves the transformer violation. The common-tower outage violation is increased by 1.7% with the addition of the third transformer. For this analysis, there were no voltage violations to report.

If there is transmission service available, it may be possible to add up to 25 MW if the generation customer is acting as an energy resource (ER), or 22MW as a network resource (NR) without additional network upgrades.

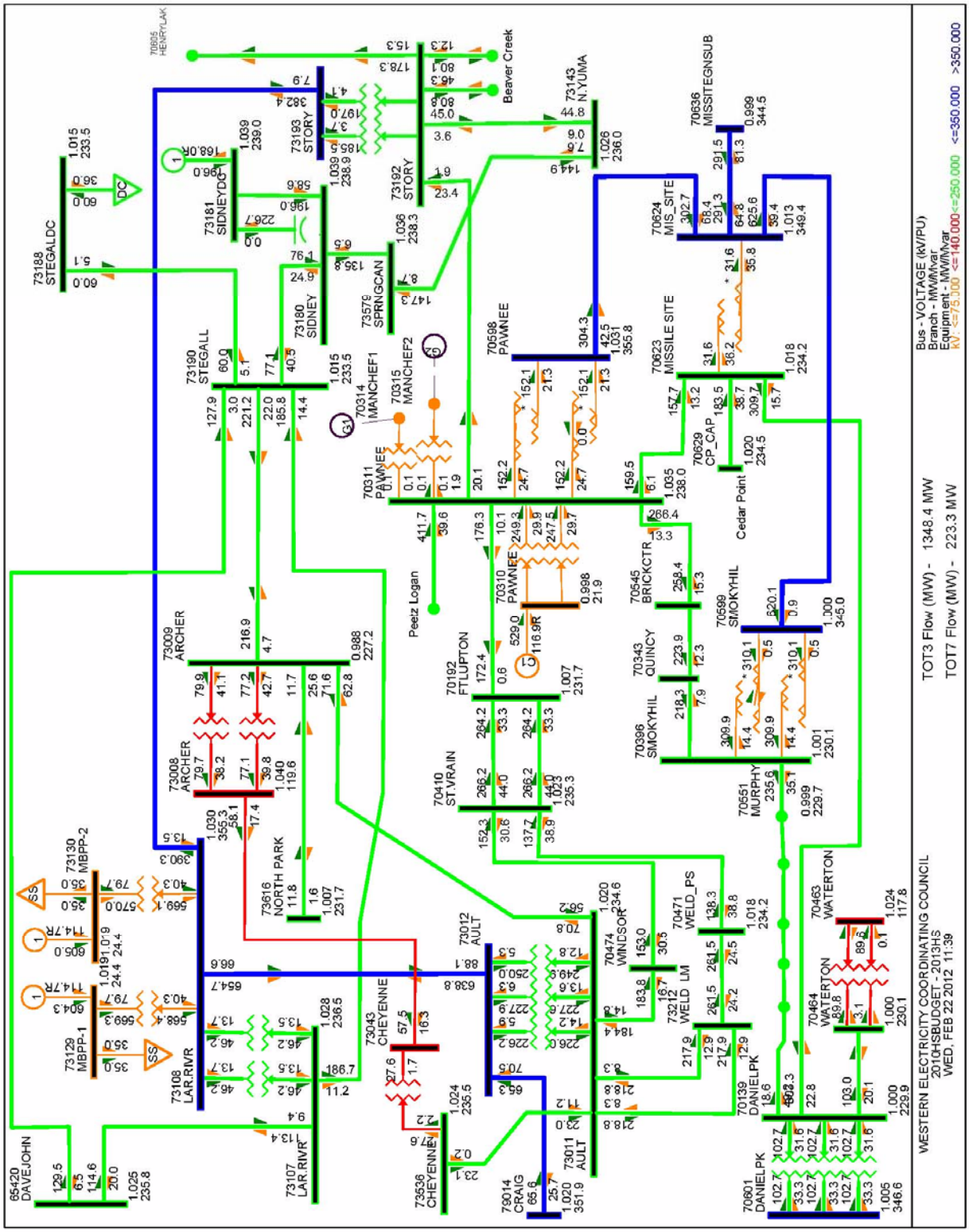
Xcel Energy

Appendix A:
Generation Levels – High TOT3 Base Case

2013HS Base Case			With GI-2008-33 Included	Base (No GI-2008-33)	
Bus#	Bus Name	Id	Pgen (MW)	Pgen (MW)	Diff
74016	WYGEN 13.800	1	32	94	-61.7
74017	WYGEN2 13.800	1	36	99	-63
74018	WYGEN3 13.800	1	50	110	-60
101	CEDAR POINT 1-2 0.6900	1	188	188	0
70034	ARAP3-4 13.800	C3-4	166	166	0
70069	CABCRKA-B 13.800	HA-B	160	160	0
70083	CANON_55-59 13.800	C1	37	37	0
70104	CHEROK2 15.500	C2	20	20	0
70105	CHEROK3 20.000	C3	137	137	0
70106	CHEROK4 22.000	C4	383	383	0
70119	COMAN_1 24.000	C1	266	266	0
70120	COMAN_2 24.000	C2	365	365	0
70777	COMAN_3 27.000	C3	584	584	0
70310	PAWNEE 22.000	C1	529	529	0
70350	RAWHIDE 24.000	C1	300	300	0
70406	ST.VR_2 18.000	G2	127	127	0
70407	ST.VR_3 18.000	G3	132	132	0
70408	ST.VR_4 18.000	G4	132	132	0
70950	ST.VR_5 18.000	G5	148	148	0
70951	ST.VR_6 18.000	G6	147	147	0
70409	ST.VRAIN 22.000	G1	309	309	0
70487	QF_TC-T4 13.800	G4	28	28	0
70487	QF_TC-T4 13.800	G5	28	28	0
70490	QF_TC-T3 13.800	ST	45	45	0
70490	QF_TC-T3 13.800	G3	28	28	0
70498	QF_BCP2T 13.800	ST	40	40	0
70498	QF_BCP2T 13.800	G3	30	30	0
70502	QF_UNC 13.800	G1	25	25	0
70502	QF_UNC 13.800	G2	25	25	0
70502	QF_UNC 13.800	G3	15	15	0
70503	PONNEQUI 26.100	W1	6	6	0
70560	LAMAR_DC 230.00	DC	-210	-210	0
70561	RAWHIDEF 18.000	GF	135	135	0
70562	SPRUCE1 18.000	G1	141	141	0
70563	SPRUCE2 18.000	G2	103	103	0
70568	RAWHIDEB 13.800	GB	48	48	0
70585	PLNENDG3 13.800	G1-7	58	58	0
70586	PLNENDG4 13.800	G1-7	58	58	0
70588	RMEC1 15.000	G1	155	155	0
70589	RMEC2 15.000	G2	155	155	0
70591	RMEC3 23.000	G3	305	305	0
70593	SPNDLE1 18.000	G1	139	139	0
70594	SPNDLE2 18.000	G2	139	139	0
70639	MISSITEGEN 0.6900	1	300	300	0
70710	PTZLOGN 34.500	W1-4	443	443	0
70721	SPRNGCAN 34.500	W1	13	13	0
70723	RDGCREST 34.500	W1	6	6	0
70823	CEDARCK_1A-2B 34.500	W1-4	116	116	0
71001	BAC_MSA GEN113.800	G1	62	71	-9.1
71002	BAC_MSA GEN213.800	G1	62	71	-9.1
71003	BAC_MSA GEN313.800	G1	30	40	-10
71003	BAC_MSA GEN313.800	G2	30	40	-10
71003	BAC_MSA GEN313.800	S1	11	20	-9
71004	BAC_MSA GEN413.800	G1	30	40	-10
71004	BAC_MSA GEN413.800	G2	30	40	-10
71004	BAC_MSA GEN413.800	S1	11	20	-9
71005	BAC_MSA GEN513.800	G1	62	71	-9.1
79902	GI-2008-33_1 13.800	1	100	New Project Unit	
79903	GI-2008-33_2 13.800	1	100	New Project Unit	
79904	GI-2008-33_3 13.800	1	100	New Project Unit	

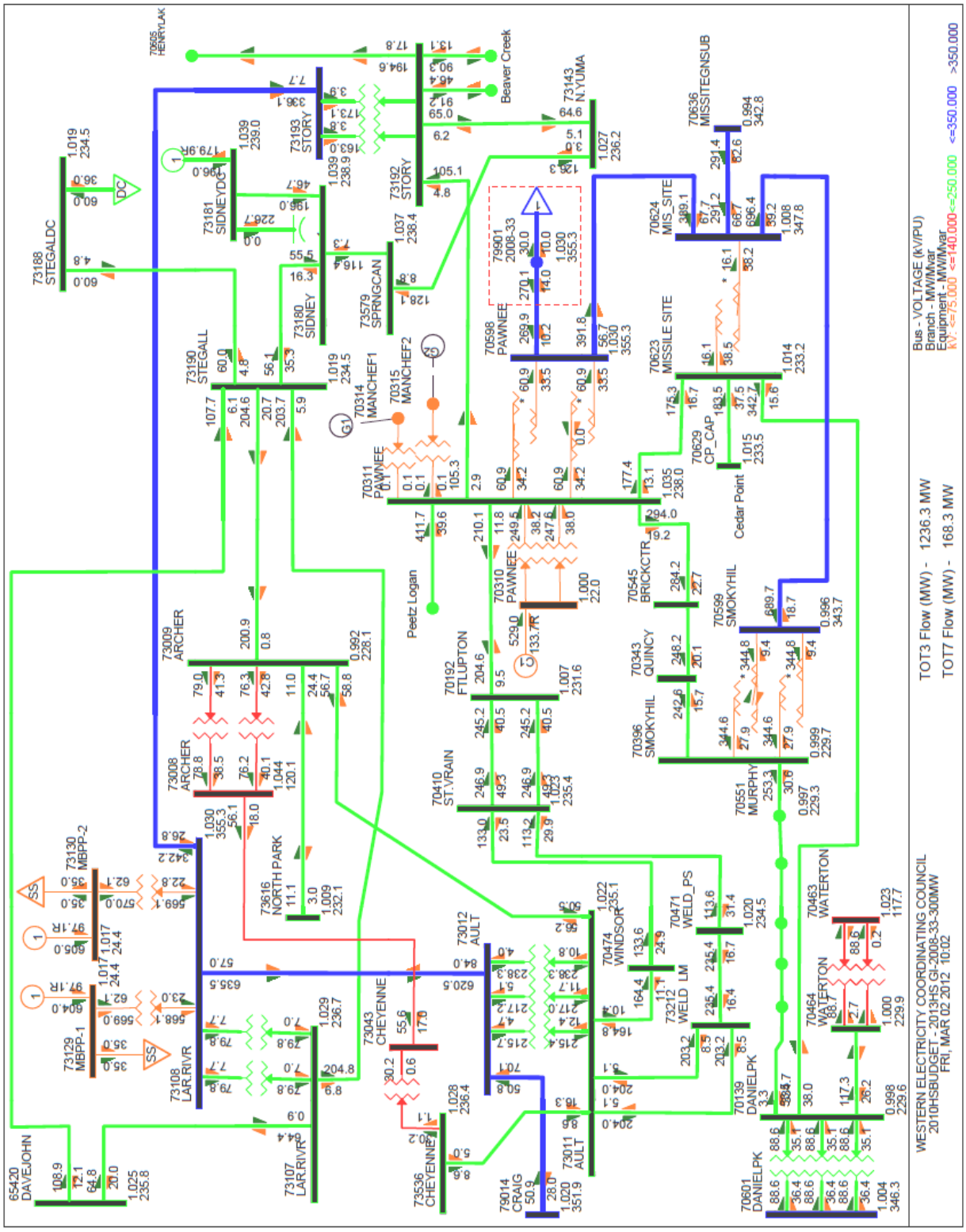
Xcel Energy

Appendix B:
Drawing B1: High TOT3 Flow Without Project



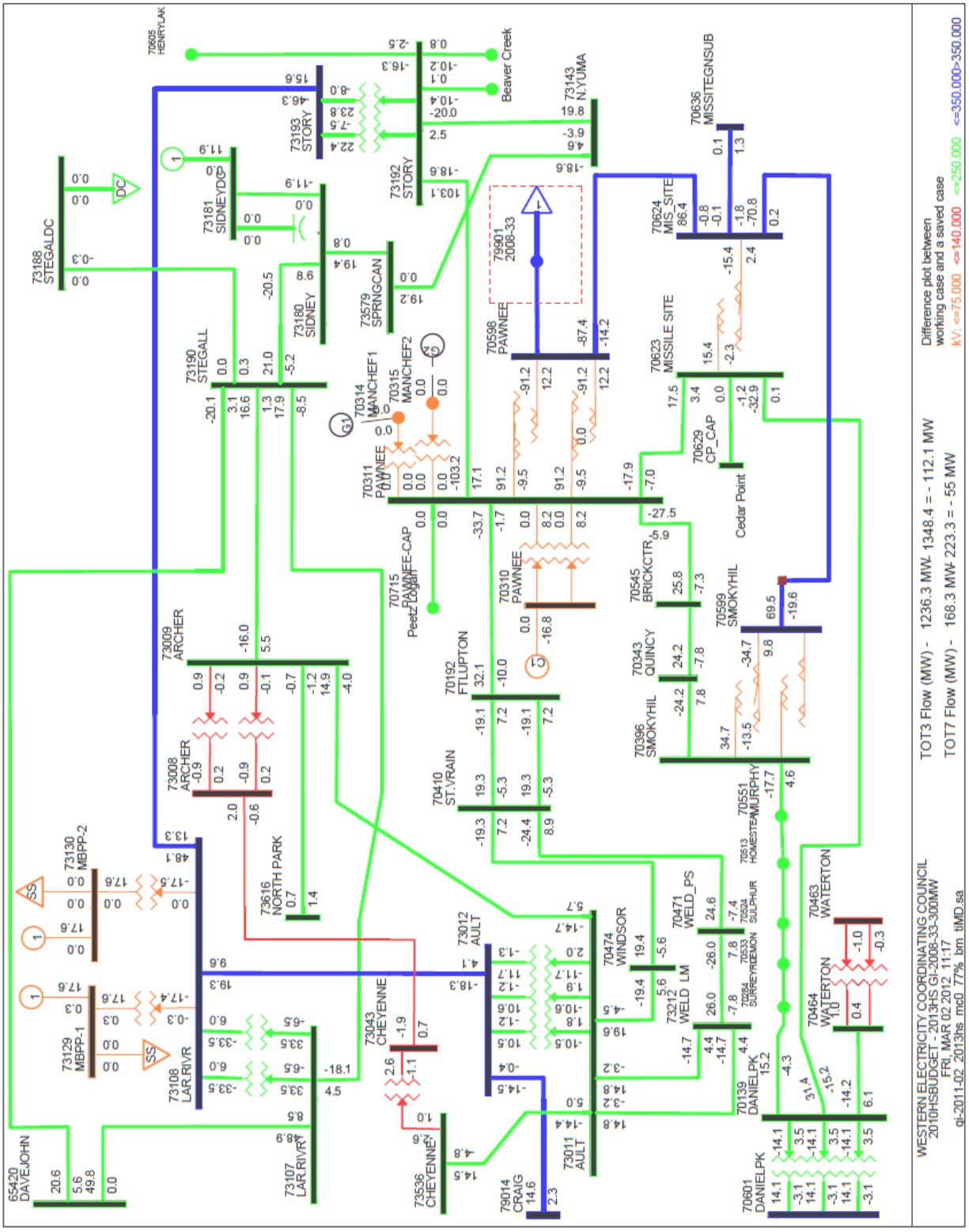
Xcel Energy

Drawing B2: High TOT3 Flow With Project

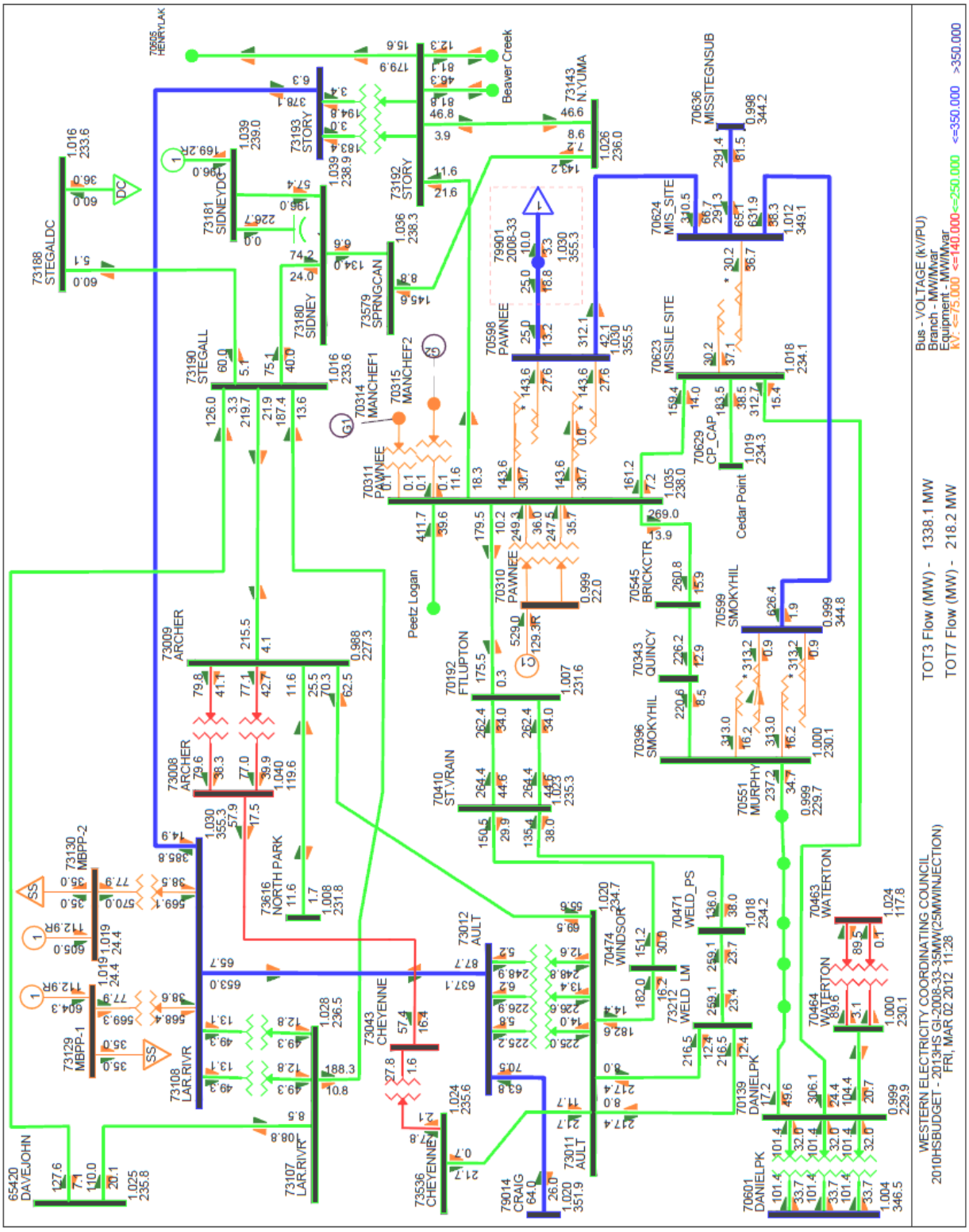


Xcel Energy

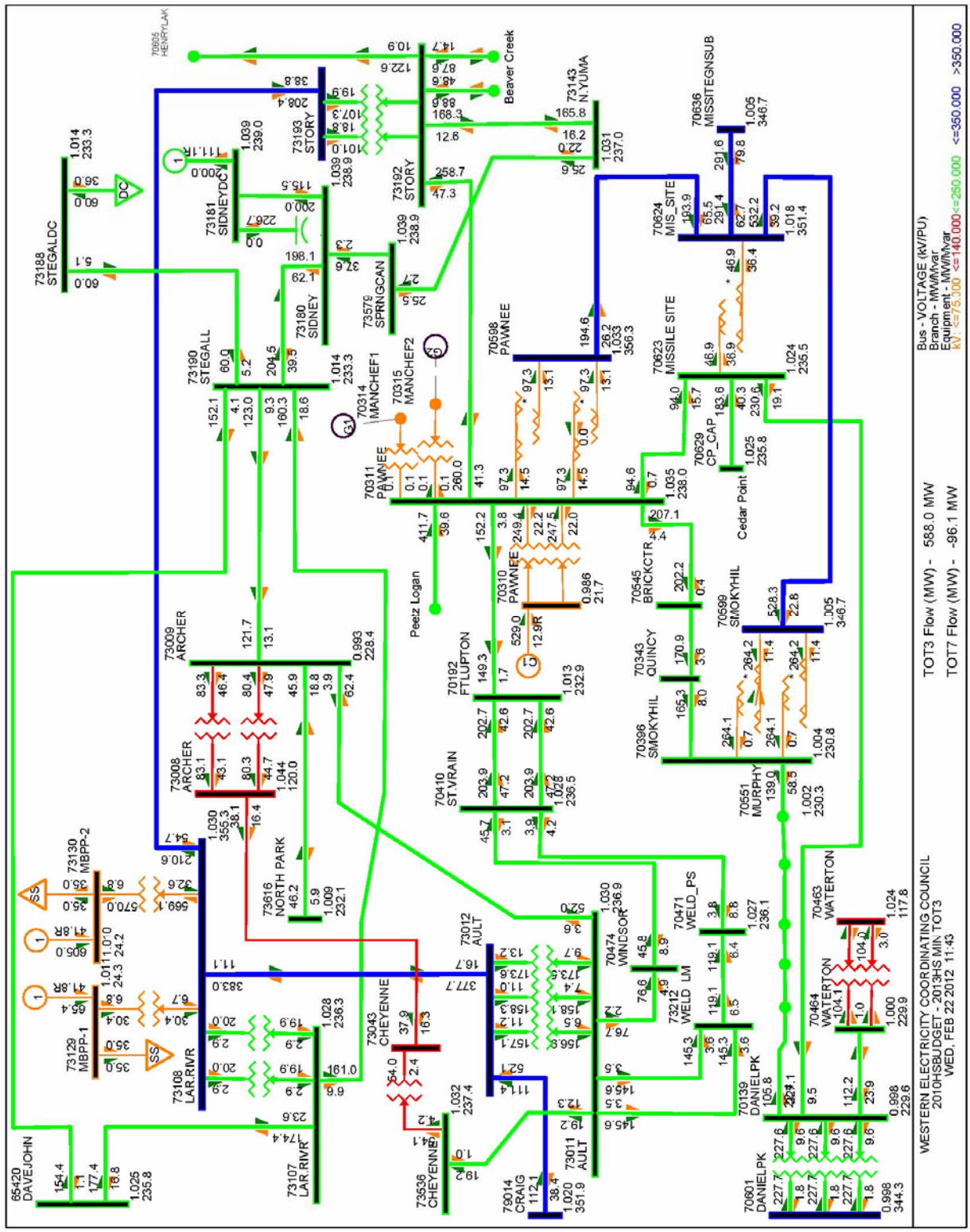
Drawing B3: Changes in Power Flows Due to Project - High TOT3 Flow



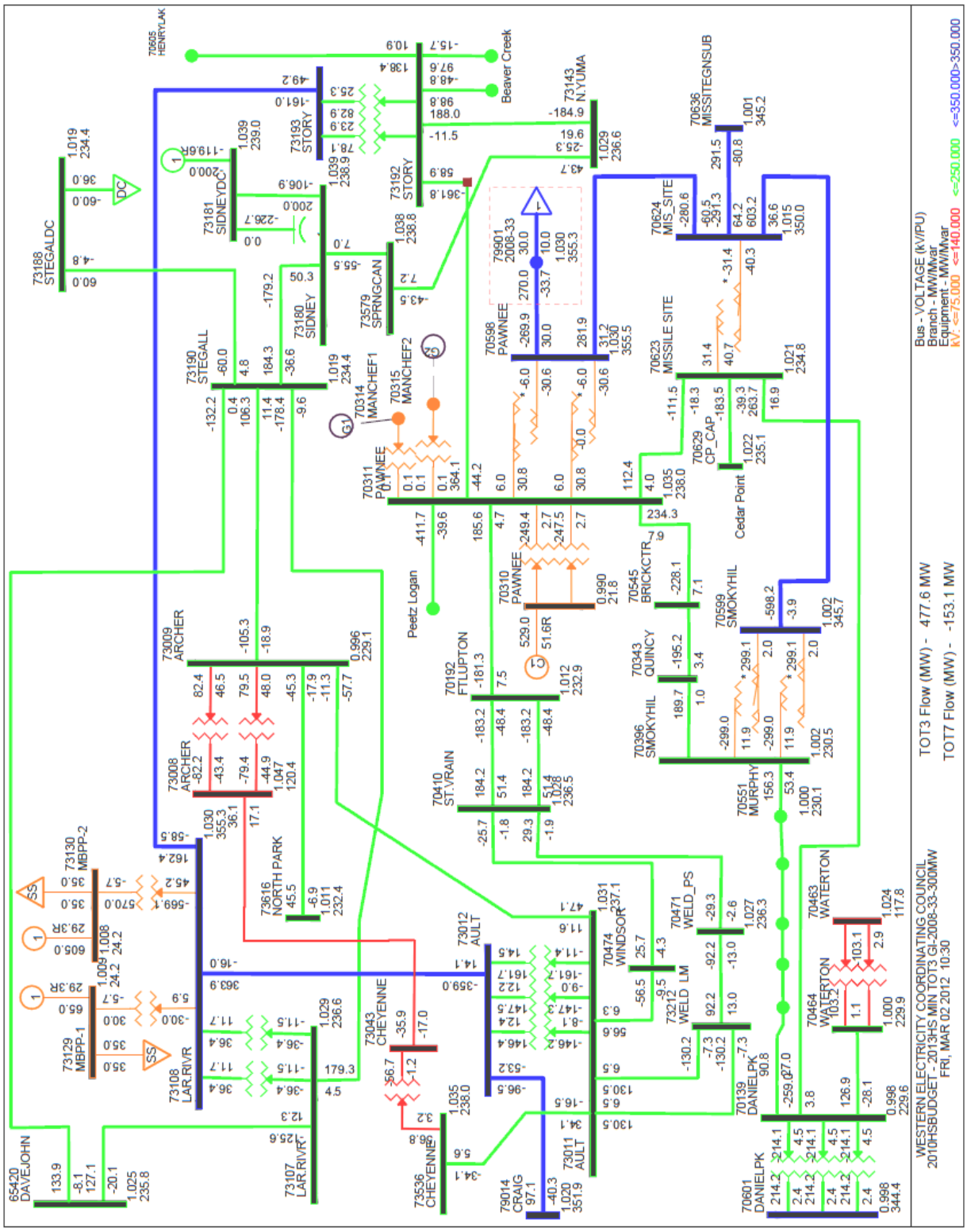
Drawing B4: High TOT3 Flow With Project Injecting 25 MW at POI)



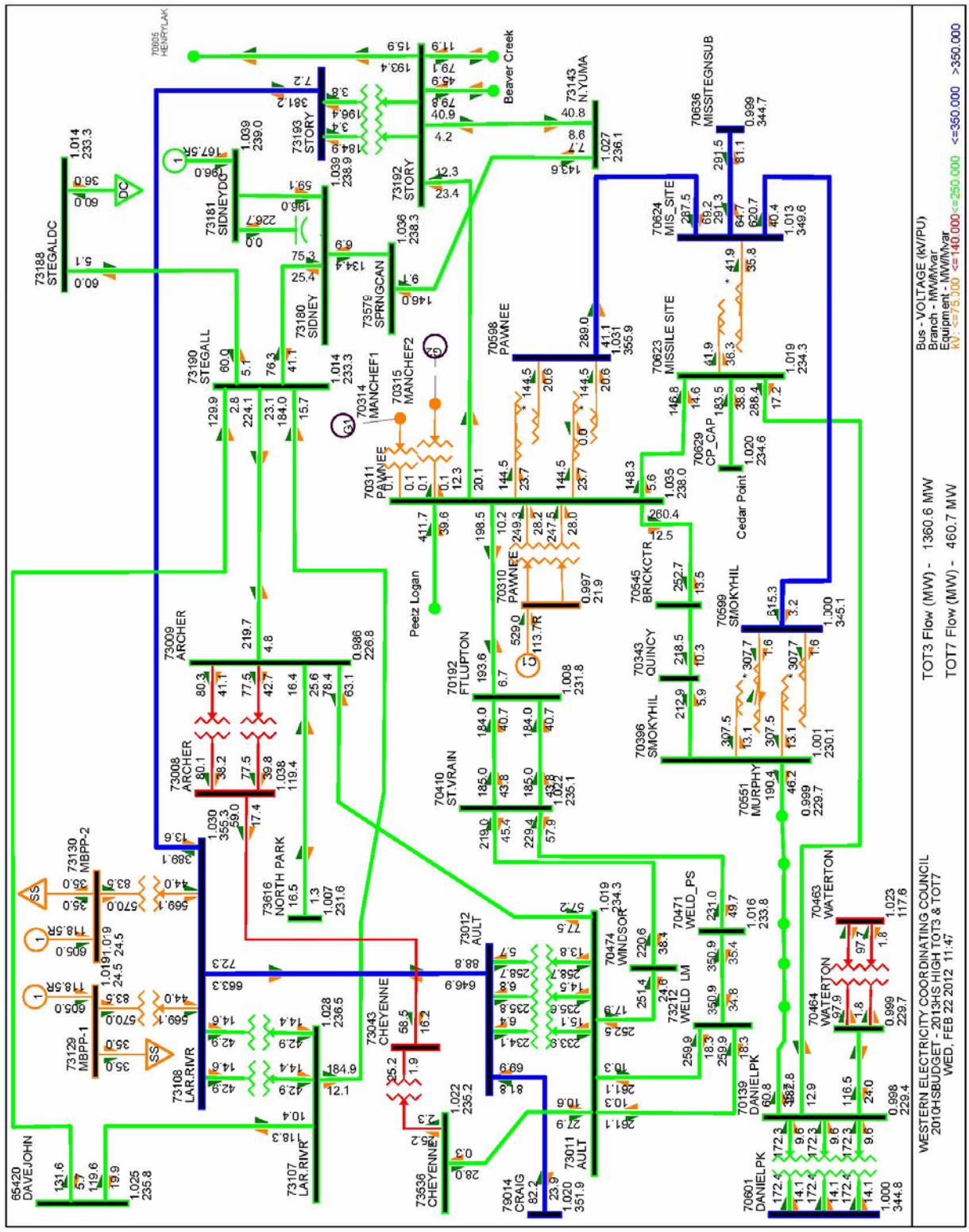
Drawing B5: Low TOT3 Flow Without Project



Drawing B6: Low TOT3 Flow With Project



Drawing B7: High TOT3 and TOT7 Flow Without Project



Drawing B8: High TOT3 and TOT7 Flow With Project