12.0 TRANSMISSION PROJECTS

The Railbelt transmission system included in this study consists of six independent utilities loosely interconnected by a transmission system that is constrained and inadequate to support interconnected operation envisioned by the GRETC concept of robust reliable service for all Railbelt utilities. One of the primary objectives of the current RIRP is to develop a transmission system that can support the economic development and operation of an integrated Railbelt system.

12.1 Existing Railbelt System

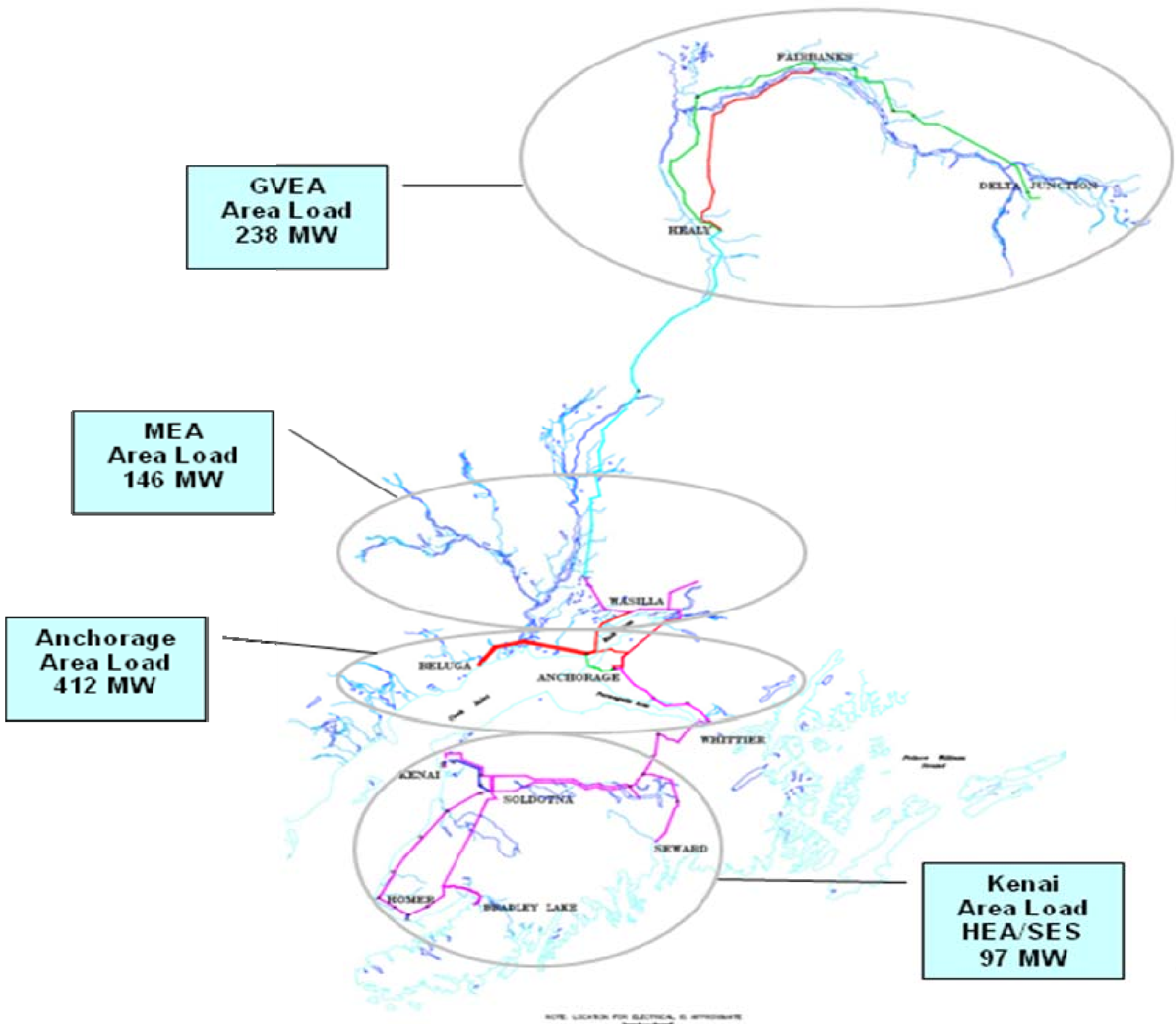
The Alaskan transmission infrastructure is relatively new compared with other transmission and distribution facilities in the lower-48 states. In the 1940s, the Chugach, GVEA, HEA, MEA, ML&P, and SES systems were formed to provide electric service to consumers within their respective service areas. The Doyon service area which is not explicitly included in this study was established in 2007 to serve the loads of the US Army bases at Fort Greely, Fort Wainwright in Fairbanks and Fort Richardson in Anchorage.

These utilities developed and operated independently of each other and were successful in providing reasonable service to businesses and residences. In 1984, the State of Alaska constructed the Anchorage-Fairbanks Intertie, and Chugach and ML&P strengthened their interconnection allowing improved operation and reliability among the utilities. In that same year, the State of Alaska and the Railbelt utilities established the Alaska Intertie Agreement. This agreement has served as the operating contract between all utilities for the past 25 years, but will expire within the next two years. Also, the expiration of the thirty-year power sales agreements between Chugach, MEA and HEA will terminate in 2014. Presumably, following the expiration of the current power sales contracts, each of the Railbelt utilities will assume the responsibility of planning the transmission system to serve its own requirements. However, the planning, repair, and construction of transmission facilities required to continue to provide economic and reliability benefits to all utilities does not fall under the responsibility of any of the specific Railbelt utilities. The expiration of the Chugach power supply contracts and the Intertie Operating Agreement leaves a void in the planning and operation of critical transmission assets required for inter-utility power transfers and reliability improvements. Changing generation plans may decrease the importance of transmission to a single utility, but the transmission will remain critical to the interconnected system. However, with the changing power supply conditions which include heightened environmental awareness, fuel cost volatility and availability, and the aging generation plants of the Railbelt, it became evident that investigation of a more coordinated approach of the Railbelt utilities to planning and operating together could provide significant benefits for the people of Alaska. The first obstacle to the goal of coordinated planning and operation is the lack of an entity that has the responsibility and authority for the planning and operation of the transmission system utilized to interconnect the systems of individual utilities. The second obstacle to coordinated generation planning and operations is the lack of an adequate transmission infrastructure to support joint economic and reliable operations. This section focuses on the transmission projects that may be necessary for the Railbelt utilities to construct a reliable transmission system that is capable of providing transfers of firm and economy energy transactions and also allow for the economic planning of firm generation capacity and reserves.

The existing Railbelt utilities cover the Fairbanks area, the Anchorage area, and the Kenai Peninsula and are interconnected between Fairbanks and Anchorage via a single transmission line known as the Anchorage-Fairbanks Intertie, while Anchorage and the Kenai are connected by a single transmission line known as the Anchorage-Kenai Intertie. These existing facilities are discussed in Section 4.

The existing Railbelt transmission system, as well as the loads supplied in each area, is presented in Figure 12-1. A significant issue affecting the existing Railbelt system results from the constrained transmission infrastructure interconnecting the utilities. This existing transmission infrastructure results in the system operation being severely constrained by stability and power transfer limits. As a result of being stability constrained, individual transmission projects constructed to increase transmission capacity cannot be fully loaded to their thermal limits and the economic sharing of reserves between utilities is also inhibited. This void cannot be filled by the existing planning and development strategy of independent utilities but should be tackled by an integrated development of the transmission system by an independent entity responsible for the planning, construction and operation of the interconnected system.

Figure 12-1
Railbelt Transmission System Overview



12.2 The GRETC Transmission Concept

One of the goals of the current study is to facilitate the development of generation and transmission systems in the most economic and reliable manner possible. By coordinating the needs of all utilities, common problems such as aging generation, unequal reliability and more levelized power supply rate structures can be developed for the Railbelt region. By assessing the problems of the system as a whole, projects that may be more economic and offer a more stable rate structure for the entire Railbelt may be developed, bringing rate stability and a dependable power cost to the entire Railbelt region.

In order to provide an organization capable of undertaking the needs of the Railbelt utilities, the Legislature is considering the formation of GRETC which would become the entity charged with planning, constructing, and operating the integrated energy and transmission system to serve the Railbelt utilities.

The corporate identity of GRETC has yet to be determined. Several organizational structures have been evaluated and will require further study. The purpose of this study is not to identify the structure of GRETC as an organization, but to identify its role in the Railbelt electrical system. GRETC's role in the Railbelt system is envisioned as follows:

Planning

GRETC will serve as the entity responsible for performing system studies, analysis, and evaluation of transmission projects, and will be required to:

- Develop plans to repair and replace (R&R) the existing transmission system as required to maintain the service and reliability of the existing system such that the future system will be at least no worse than the reliability and transfer capacity that exist today.
- Develop plans to repair, replace and maintain the communication and control system required to ensure system reliability and economic operation.
- Develop long-range transmission plans (LRTP) to identify transmission projects required over the next 50 years to provide the same or comparable reliability and service to all Railbelt utilities.
- Develop generation and transmission plans such that at the completion of each plan, no single contingency within the GRETC system results in the loss of firm load.
- Develop mid-range transmission plans (10-Year Plan, or TYP) to prioritize the transmission projects identified in the LRTP and R&R plans into a single plan that is consistent with the requirements of the Railbelt utilities and within the financing capability of GRETC.
- Develop and maintain rolling Five-Year Plans (FYP) that identify the projects to be constructed within the next five years as outlined in the TYP. Develop project schedules, including permitting and right-of-way (ROW) schedules for long-term projects.
- Develop design criteria for each project identified in the plan, develop the design, construction management, construction, and close-out schedules and budgets.
- Administer design, construction management, and construction contracts associated with the projects.

Operation

- GRETC should be responsible for operation of the transmission and generation system required to deliver power between GRETC generation or GRETC delivery points to Railbelt utilities to ensure that each utility, over the long-term planning horizon receives comparable service in terms of transmission reliability, access to reserves, and transmission costs.

- GRETC should be responsible for the economic operation of the Railbelt generation system, ensuring that power throughout the Railbelt is produced in the most economical manner possible.
- GRETC should be responsible for allocation of reserves to ensure system reliability is maintained at no worse than existing levels.

In developing projects for the integrated operation of the Railbelt transmission system the following criteria were adopted:

- The transmission system will be upgraded over time to remove transmission constraints that currently prevent the coordinated operation of all the utilities as a single entity. The transmission planning period is 50 years. The ability of GRETC to construct the transmission improvements identified in this study within any certain time period is unknown. The prioritization of the transmission projects and their subsequent schedule for construction cannot be completed in the scope of this study. As such, this study attempts to identify required transmission improvements for evaluation in future studies.
- The study includes all the utilities' assets, 69 kV and above, that are used to transmit power from a GRETC generator to the Railbelt system or between significant load areas. These assets, over a transition period, may flow into GRETC and form the basis for a phased upgrade of the system into a robust, reliable transmission system that can accommodate the economic operation of the interconnected system. Utility assets, 69 kV and above, that are not used to transmit power between GRETC generation or between GRETC transmission delivery points may or may not be transferred to GRETC.
- Generation assets not utilized by GRETC for power delivery, reserves or other uses may be retained by the individual utilities for their own uses such as emergency generation, load-side generation, load serving etc.
- The study assumes that all utilities participate in GRETC with transmission and generation planning being conducted on a GRETC (i.e., regional) basis. The common goal would be the tight integration of GRETC with the utilities for planning and operations as previously described.

12.3 Project Categories

The projects selected for consideration were based on the overall GRETC concept of developing a robust, reliable transmission system that can accommodate the economic operation of the Railbelt integrated system. Discussions were held with the utilities and a list of potential projects was developed for further consideration. The projects were classified in the following categories:

- Transmission systems that need to be replaced because of age and condition (Category 1)
- Transmission projects required to improve grid reliability, power transfer capability, and reserve sharing (Category 2)
- Transmission projects required to connect new generation projects to the grid (Category 3)
- Transmission projects to upgrade the grid required by a new generation project (Category 4)

In developing the system, reliability remains a significant focus. Redundancy is one way to increase reliability, but may not be the only way to improve or maintain reliability as indicated in the analysis below.

12.4 Summary of Transmission Analysis Conducted

A transmission analysis consisting of power system load flows and N-1 analysis was conducted to determine the deficiencies of the existing system. In the existing transmission system, constraints preclude the economic development of large projects that are common to the entire Railbelt. Lack of transfer capacity and single contingency interties prevent projects being developed in any one area to serve firm power to the entire region. Improvements to the power system required to alleviate overloads, transfer limitations and address

N-1 contingencies under the existing generation and the generation configurations developed as part of this plan were identified as projects and evaluated in power flow studies to determine if the resulting system satisfied the main objectives and criteria set for the RIRP. Identified projects were evaluated to determine if the system could supply the projected load under economic generation dispatch without violating the transmission criteria of no loss of load or voltage violations under the N-1 criteria as well as to establish a redundant system with a 230 kV backbone through the Railbelt. Similar to the generation alternatives, this plan has identified possible projects that are required to meet the goals and objectives of GRETC. Prioritization and detailed development of the projects should be completed concurrent with the subsequent generation plan to provide a comprehensive and coordinated approach to serving the Railbelt utilities.

12.4.1 Cases Reviewed

The base case for 2060 was evaluated with all the projects included, along with the load forecast for 2060 as developed for the RIRP. The generating resources selected by the RIRP for the different scenarios were also modeled for the respective cases. With each case developed, the generating resources were dispatched economically and several contingencies evaluated to determine if there were any constraints on the Railbelt transmission system. A review of the recent projects designed and constructed for the Railbelt utilities, has revealed that many projects have been designed at a higher voltage than the existing voltage of the line. In many cases, the circuits have been rebuilt to a higher voltage but placed back in operation at the same voltage awaiting an opportunity to increase the capacity of these circuits when appropriate. These lines, in many instances, have been insulated to operate at 230 kV from the existing 115 kV or 138 kV levels. To capture the benefits of increased transmission capacity, as well as to capture the benefits of standardizing transmission voltages at a specific level thus controlling operation and maintenance costs going forward, standardization of the Railbelt transmission grid at 230 kV was determined by Black & Veatch, EPS, and the Railbelt utilities to be appropriate. This key concept of developing a reliable transmission backbone for the Railbelt occasionally results in projects that are designed and constructed at a higher voltage but operated at a lower voltage until the transition to the higher voltage can be facilitated or justified This is particularly applicable in the repair and replacement of existing transmission facilities. Portions of the existing Railbelt transmission system are not recommended to be included in the 230 kV upgrade due to difficulties in obtaining ROW and other considerations. As a result, portions of the existing 115 kV system on the Kenai, ML&P and MEA areas would remain at 115 kV and portions of the Chugach and GVEA systems would remain at 138 kV throughout the life of this plan.

In accordance with the ideals of GRETC, some of the existing transmission systems would not be incorporated into the GRETC system, but would remain with the local utility to own, operate and maintain for its own use.

Since the repair and replacement of the existing transmission facilities is scheduled over many years, it is likely that that the initial portions of a transmission line replacement project will be operated at its existing voltage for many years until the entire transmission line is replaced and a justification to convert any required substations and operate the transmission line at its ultimate construction voltage is warranted.

The above analysis was based on load flow evaluations with consideration given to possible stability issues. The development of the final transmission plan will require more detailed studies, analysis and integration with the selected generation plan. The projects that are interrelated with generation scenarios will require evaluation concurrent with more detailed generation scenarios. Projects that are independent of generation scenarios can undergo detailed studies, including stability analysis and detailed evaluation prior to selection of the preferred generation scenario. The results of these future studies may result in some changes to the projects identified.

12.4.2 Results of 2060 Analysis

The transmission analysis included normal and N-1 contingency analysis of all transmission branches in the Railbelt, with all the generating resources dispatched economically. The power flow analysis was evaluated to determine if any overloads or voltage violations of any of the transmission lines within the Railbelt system occur during both normal and N-1 conditions.

Limited stability studies were completed to evaluate the ability of the Railbelt system to operate for select cases. As future studies refine transmission and generation projects, additional power flow and stability studies will be required to evaluate the requirements of the transmission system.

12.5 Proposed Projects

Project A – Bernice Lake Power Plant to International 230 kV Transmission Line (Southern Intertie) (New Build - Category 2)

The Bernice Lake Power Plant to International Substation 230 kV project is a new 230 kV line between the Anchorage area and the Kenai. The project commences at the ITSS substation, crosses Turnagain Arm via submarine cable and an overhead crossing of Fire Island and proceeds overhead along the coastline to the Bernice Lake Substation. The project is comprised of a total of 15 miles of submarine cable and 47 miles of overhead transmission line. The project is intended to follow the recommended route included in the Environmental Impact Statement managed by Chugach.

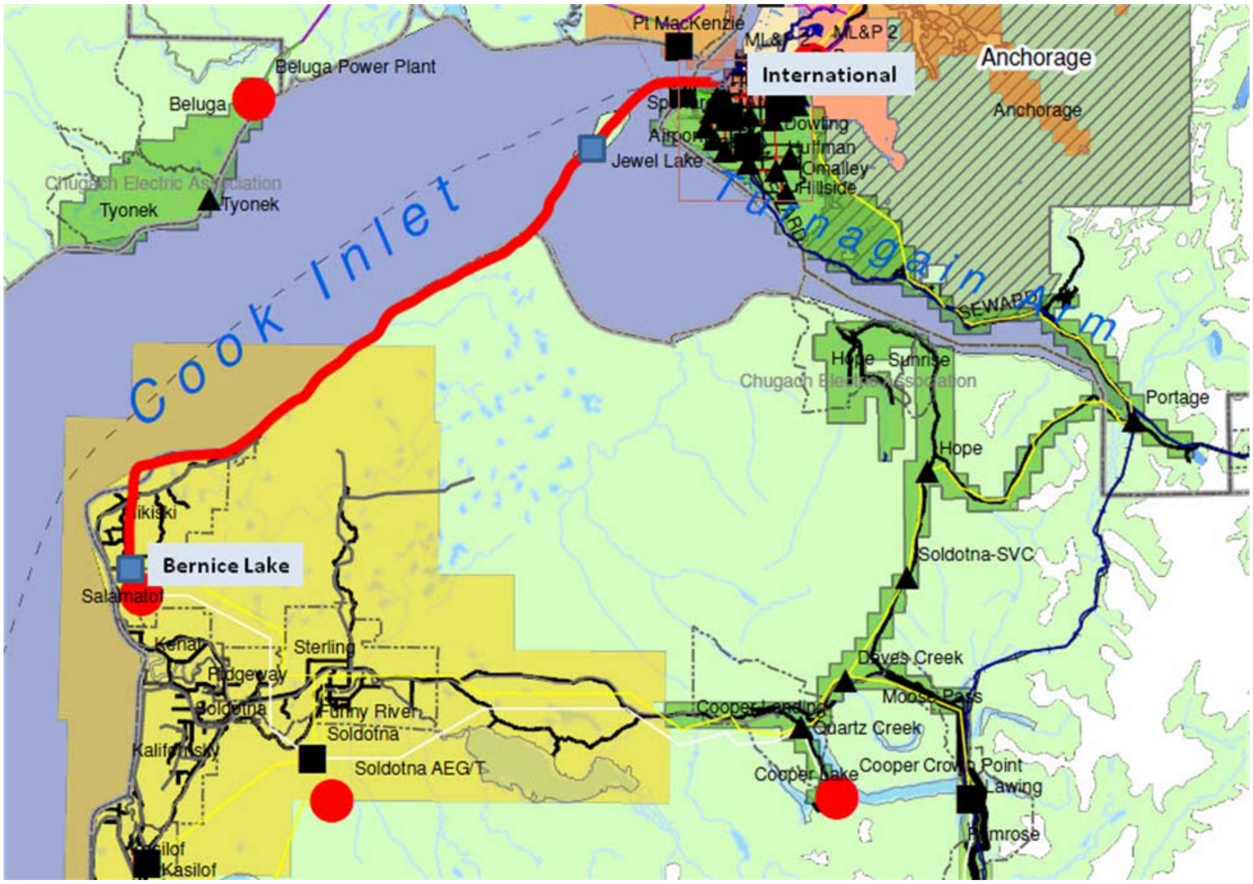
The single transmission line between Anchorage and Kenai prevents the economic construction of generation in the Railbelt, and places constraints on both the amount of power that can be exported from the Kenai area and the amount of power that can be imported into the Kenai area.

In addition to the export and import of energy to the Kenai, the ability to utilize reserves across this single transmission line is a severe restriction to the economic operation of the system as a whole. For instance, if the Bradley reserves are increased to 50 MW, the ability of the northern utilities to utilize these additional reserves is questionable since the transfer of these reserves requires transmission across the single tie-line that is already transferring real power to the northern utilities and the transfer of these reserves is beyond the stability limit of the transmission system.

In order to meet the planning criteria that no N-1 contingency results in the loss of load from the GRETC system, without a second tie-line, the generation on the Kenai has to be severely constrained to limit power transfers into the Kenai area. This constraint increases both capital and operating costs for the Railbelt, forcing the location of new generation on the Kenai as well as new generation in the northern parts of the system to supply reserves that are not transferable across the existing transmission line.

This project is the second intertie between the areas and is required to increase the transfer limit between the two areas. The current transfer limit between the areas is limited due to stability considerations to 75 MW. The steady-state limit is constrained to 105 MW (winter) due to voltage collapse while the thermal limit for the existing 115 kV transmission line is approximately185 MW (winter) and 95 MW (summer). This project is a Category 2 project required for reliability and increased transfer capability. Figure 12-2 presents the proposed project. More investigation is required to determine detailed transmission characteristics and routing.

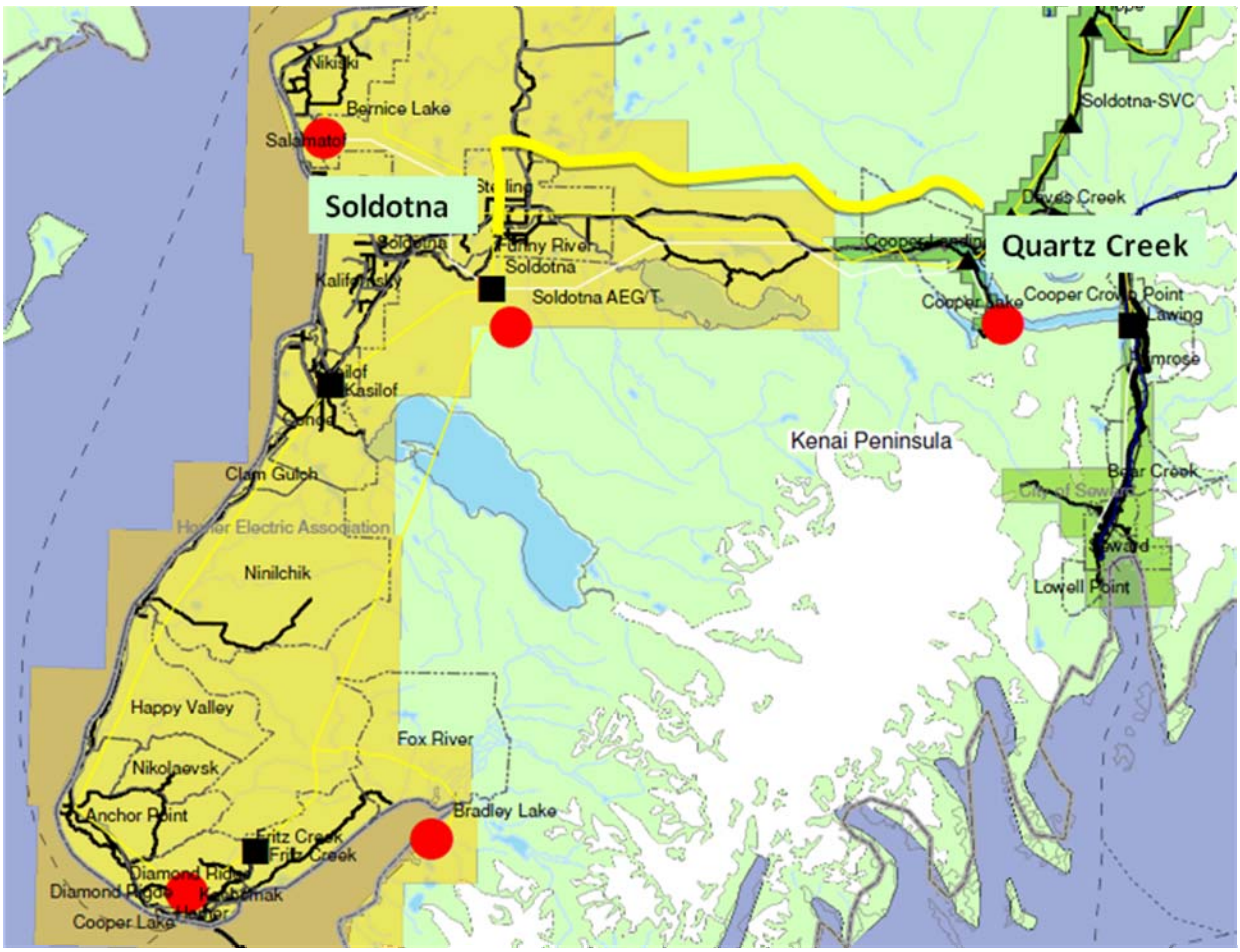
Figure 12-2
Bernice Lake Power Plant to International 230 kV Transmission Line (New Build)



Project B – Soldotna to Quartz Creek 230 kV Transmission Line (Repair and Replacement - Category 1)

This project is the upgrade of the existing 54-mile long, 115 kV transmission line between Soldotna and Quartz Creek substations. This line was constructed in 1959 and is in very poor condition, suffering from frost jacking and age deterioration. The transmission line is a continuation of the Anchorage – Daves Creek line and results in the same stability and reliability constraints as the Project 1-line described above. Because of the importance of this intertie to the integrated operation of the Railbelt system, this line is proposed to be rebuilt for operation at 230 kV. The line would continue to operate at 115 kV until conversion to 230 kV operation is warranted. Figure 12-3 presents the proposed upgrade.

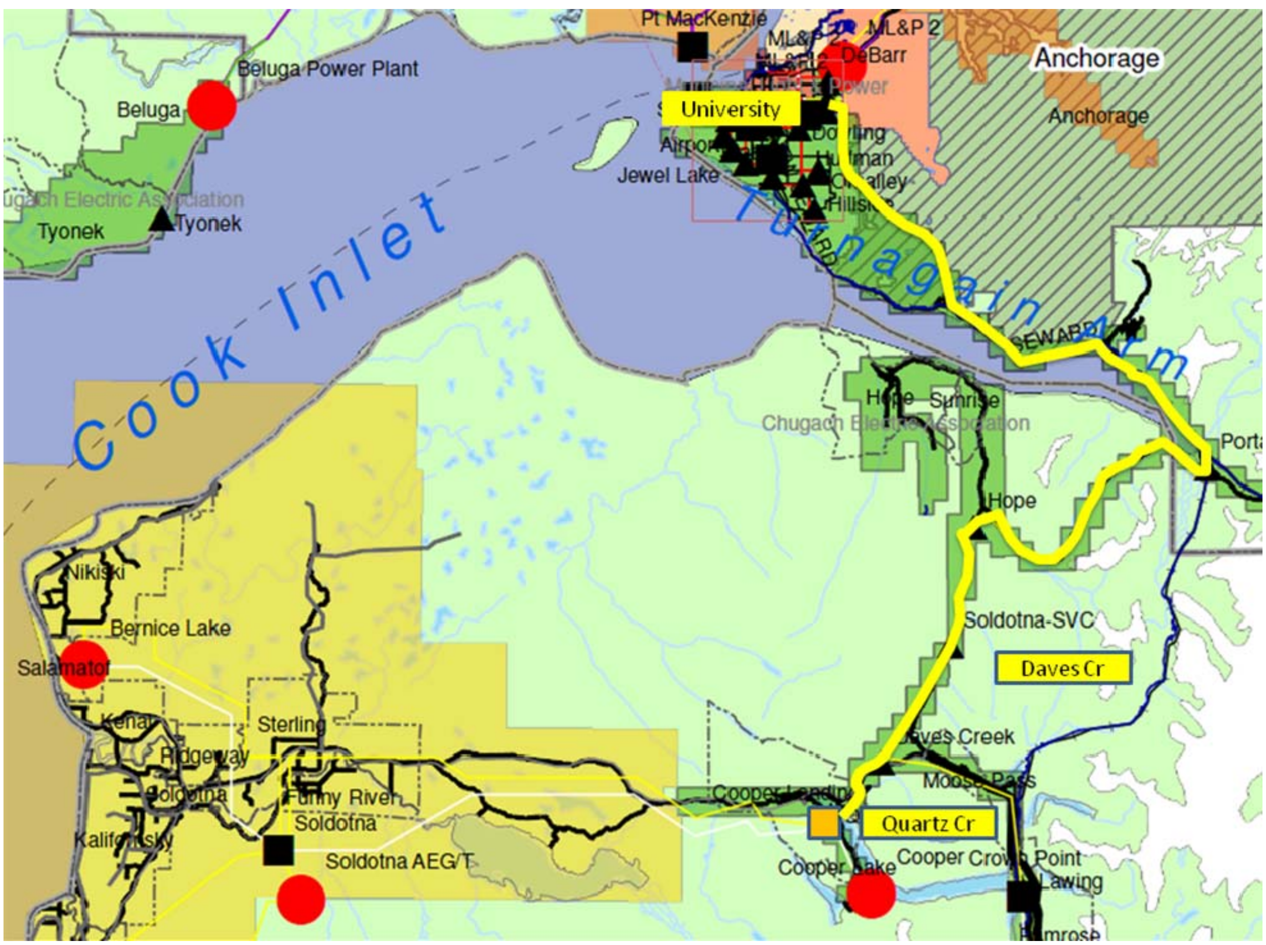
Figure 12-3
Soldotna to Quartz Creek 230kV Transmission Line (Repair and Replacement)



Project C – Quartz Creek to University 230 kV Transmission Line (Repair and Replacement - Category 1)

This is the section of the existing 115 kV Kenai Intertie owned by Chugach and was constructed in 1959 and consists of two sections. The first section is from Quartz Creek to Daves Creek and is approximately 7.7 miles long. The second section is from Daves Creek to University and is approximately 68.2 miles long. Portions of this line have been upgraded over time however approximately 65 percent of this wood pole line is over 50 years old and is subject to avalanches and severe weather conditions. It will require significant rebuilding to keep it in service over the life of this plan. The line is considered a critical component of the transfer capability between the Anchorage and Kenai areas and is also required for reliability and reserve sharing. The current transfer limit between the areas is limited due to stability considerations to 75 MW. The steady-state limit is constrained to 105 MW due to voltage collapse while the thermal limit for the existing 115 kV transmission line is approximately185 MW in the winter and 95 MW in the summer. The line is recommended to be upgraded to 230 kV over the life of this plan to increase the stability limit transfer capability and reserve sharing between the areas. Figure 12-4 presents the proposed upgrade.

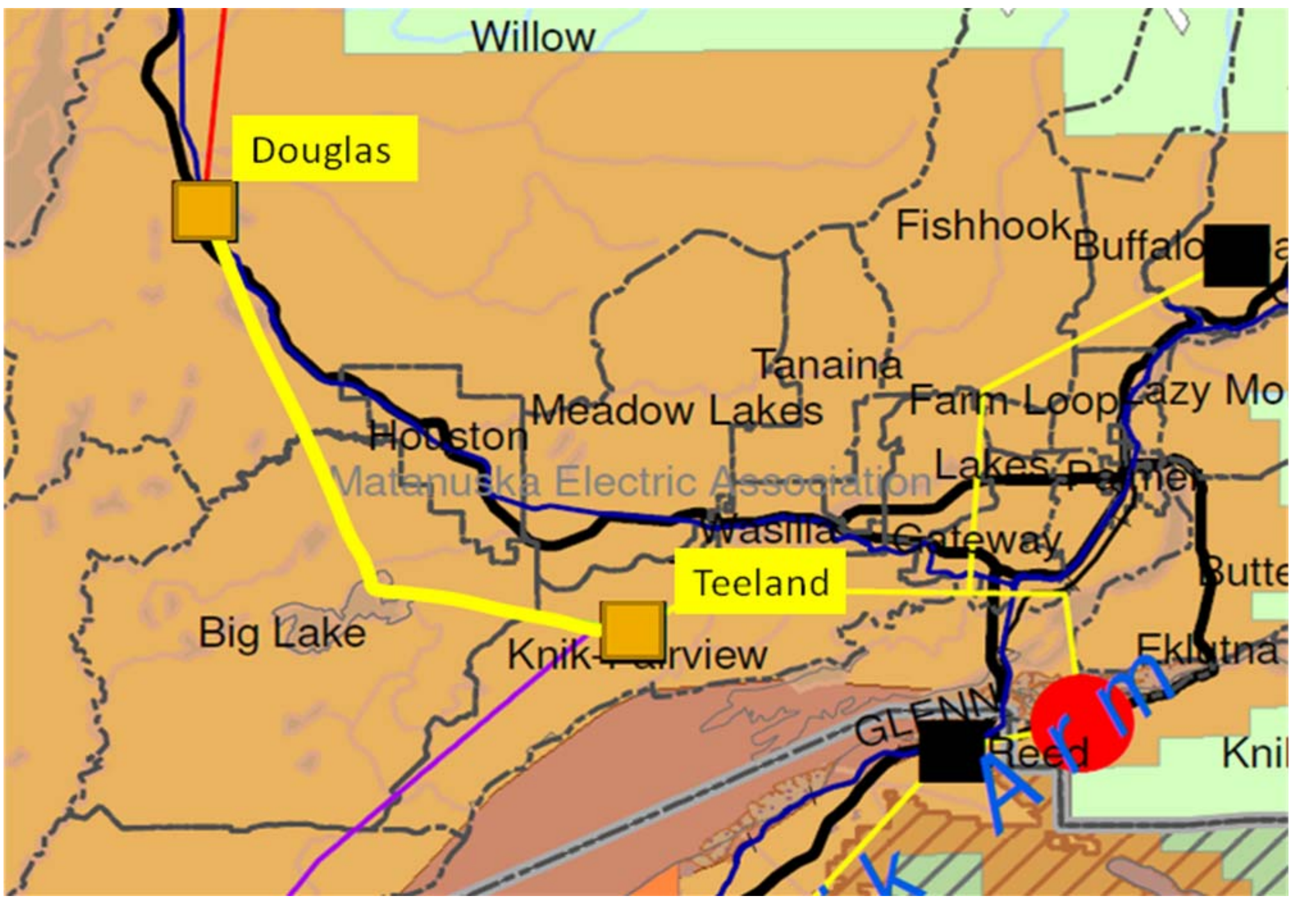
Figure 12-4
Quartz Creek to University 230kV Transmission Line (Repair and Replacement)



Project D – Douglas to Teeland 230 kV Transmission Line (Repair and Replacement - Category 2)
The Douglas to Teeland line was originally constructed for operation at 115 kV and currently operates at 138 kV and serves as the final line section of the Anchorage-Fairbanks Intertie.

The construction of the Lorraine-Douglas line described below and the upgrade of the Anchorage-Fairbanks Intertie to 230 kV requires the upgrade of this line section to 230 kV to form a transmission loop between Lorraine-Teeland and Douglas stations. The proposed loop will eliminate single contingency outages to the southern portion of the Intertie and permits higher transfer limits between load and generation areas. The line should be constructed following the completion of the Lorraine – Douglas line section to mitigate the impact of the line's construction on energy transfers between the Anchorage and Fairbanks areas. Figure 12-5 presents the proposed upgrade.

Figure 12-5
Douglas to Teeland 230 kV Transmission Line (Repair and Replacement)



Project E – Lake Lorraine to Douglas 230 kV Transmission Line (New Build - Category 2)
Pt. MacKenzie substation is a key component in the Railbelt transmission grid, serving as the hub of electrical power generated at Beluga and providing interconnections to all other utilities. Teeland substation currently serves as the sole terminus of the Anchorage-Fairbanks Intertie and also as the primary source of power for MEA's consumers in the Palmer-Wasilla area.

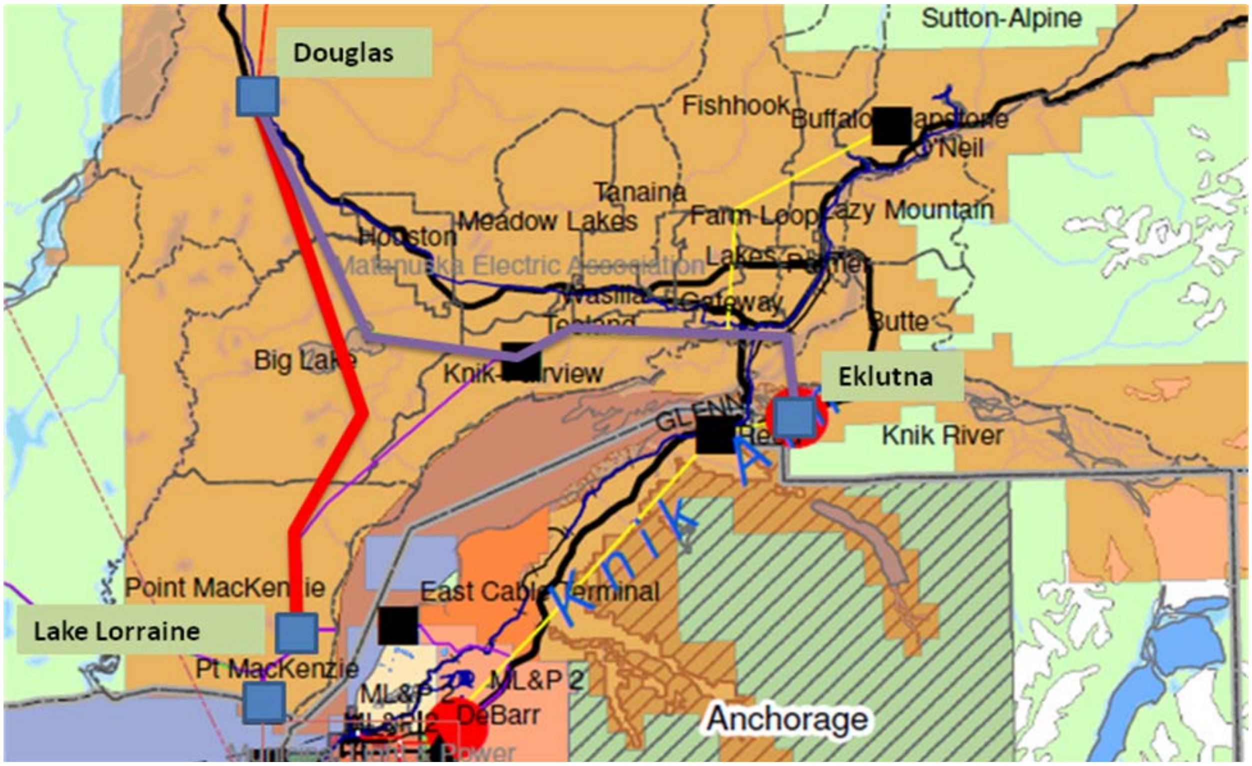
The Pt. MacKenzie–Teeland transmission line is the heaviest loaded line in the Railbelt, often carrying over 200 MW during peak months. By comparison, the Anchorage-Kenai Intertie is constrained to no more than 75 MW during its peak loading and the Anchorage-Fairbanks Intertie is restricted to less than 85 MW. Under both summer and winter loading conditions, the loss of the Pt. MacKenzie-Teeland transmission line results in unstable conditions in the Anchorage-Kenai transmission system during certain generation conditions. This instability is in addition to the blackout of approximately 25 percent of the Railbelt consumers caused by the line outage. The unstable conditions could result in widespread blackouts from Fairbanks to Homer. In the worst case, the system will suffer a complete blackout, with a risk of damage to Railbelt generators.

The construction of a new substation at Lake Lorraine, with a new transmission line to Douglas Substation provides a transmission loop between Pt. MacKenzie, Lake Lorraine, Teeland and Douglas substations will eliminate the largest single contingency in the Railbelt system. Following the completion of the Lorraine-Douglas line, the loss of any single transmission line in this loop will not result in widespread outages in the Fairbanks and Mat-Su areas.

The construction of the Lake Lorraine-Douglas transmission line has a dramatic impact on the reliability of service to the Railbelt consumers. The elimination of a single point of failure for the entire electrical system in the summer conditions is achieved. In both winter and summer conditions, outages to all consumers in the Palmer – Wasilla areas and a significant number of consumers in the Fairbanks area by the failure of a single transmission line are eliminated. The stability margin for the winter conditions is improved, but unlike the summer conditions, the risk of system instability is not eliminated.

This project will also require the upgrade of the existing SVCs at Teeland, Healy and Gold Hill. These SVCs were installed in 1984 as part of the original Intertie construction. The SVC components are no longer manufactured or available from third party vendors. Spare parts have been exhausted and replacement components cannot be obtained. Loss of the SVCs is critical to the operation of the Intertie and the economic transfer of both energy and capacity between Anchorage and Fairbanks. Figure 12-6 presents this proposed project.

Figure 12-6
Lake Lorraine to Douglas 230 kV Transmission Line (New Build)



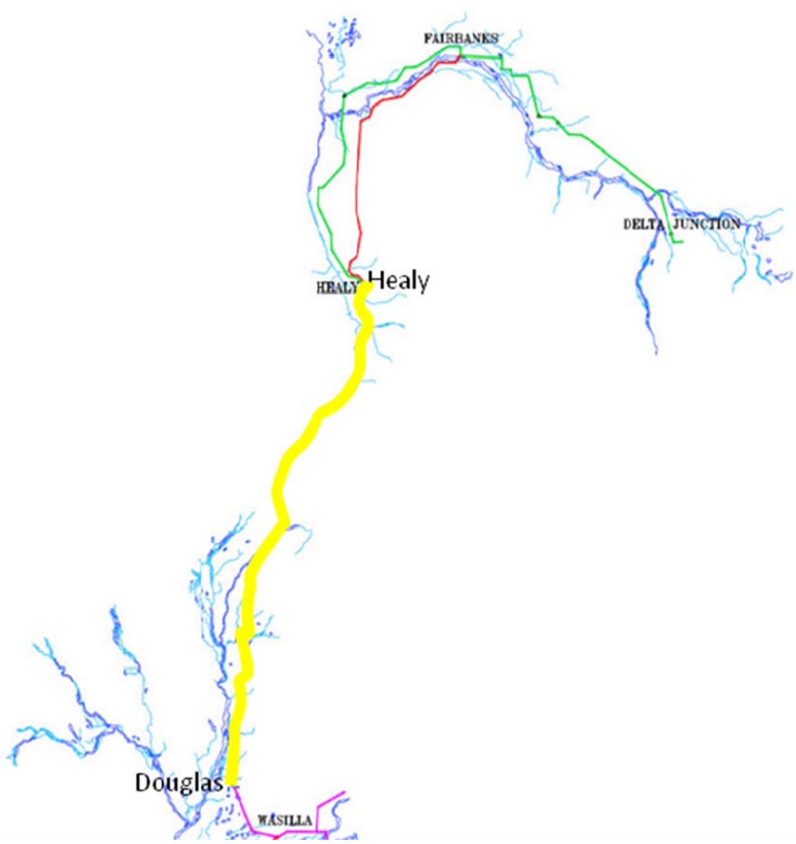
Project F – Douglas to Healy 230 kV Transmission Line (Upgrade - Category 2)
The Alaska Intertie includes a 170-mile, 345 kV transmission line between Willow and Healy and voltage control devices at Teeland, Healy and Gold Hill Substations. The line built with State grant funds, went into operation in 1985, and is operated at 138 kV.

The line is the state-owned portion of the 300 mile Anchorage to Fairbanks transmission system. The Intertie allows GVEA to purchase lower cost energy from Anchorage and the Kenai generated from natural gas and the Bradley Lake hydroelectric project. Chugach and ML&P generate revenue from the sale of economy energy to GVEA. The line also allows reserves, both operating and non-operating to be shared between the northern and southern areas of the system.

The ability to import power into the Fairbanks area is limited to the current stability limit of approximately 85 MW. Although stability aids could increase this power transfer capability, the amount of power transferred over the intertie would still be limited to approximately 85 MW as this is considered the maximum allowable import limit into the Fairbanks area to survive the N-1 contingency of the loss of the intertie.

The proposed transmission line upgrade will allow power transfers to increase from the existing limit of approximately 85 MW and will eliminate the loss of load associated with an N-1 contingency and bring the Fairbanks GRETC area into compliance with the planning criteria following the completion of the second transmission line. Figure 12-7 presents the proposed transmission line.

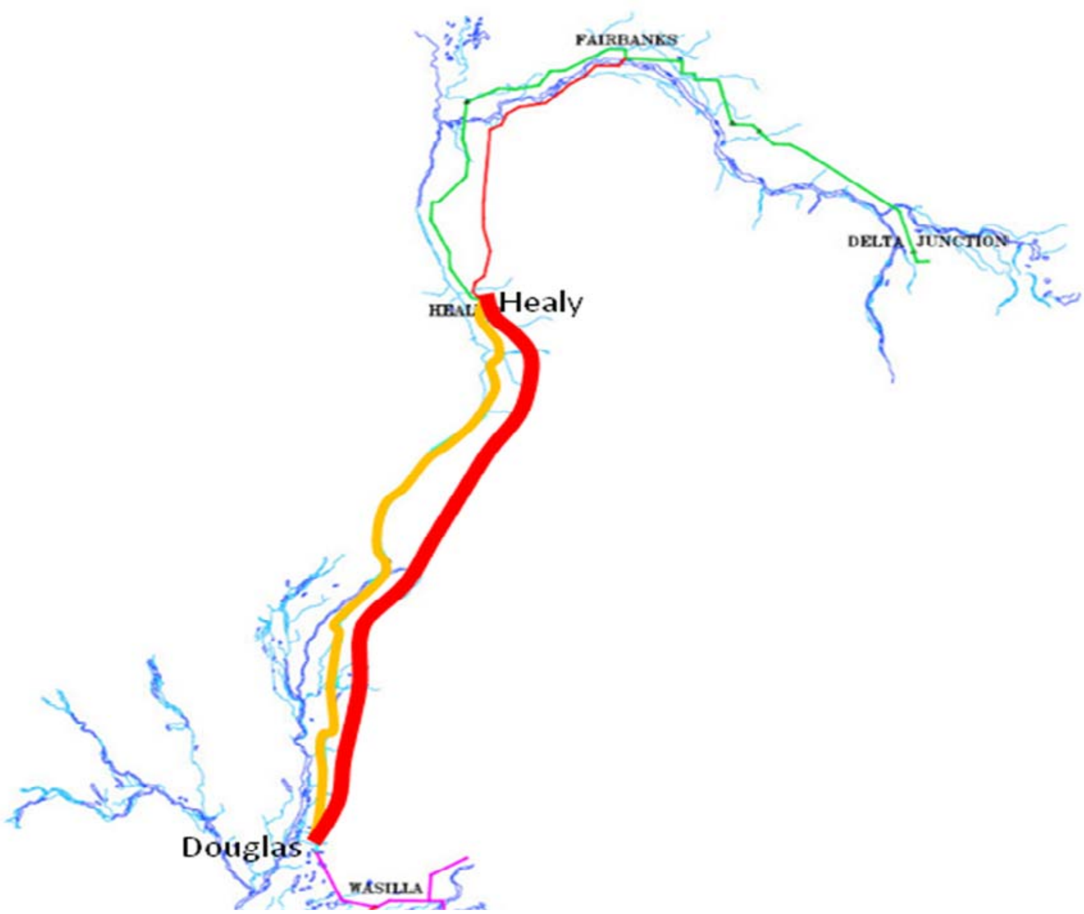
Figure 12-7
Douglas to Healy 230 kV Transmission Line (Upgrade)



Project G – Douglas to Healy 230 kV Transmission Line (New Build - Category 2)
An additional line between the Douglas and Healy substation is required to meet the reliability criteria for no loss of load for any N-1 condition and to increase the transfer capability between the northern and central portions of the Railbelt. The ability to import power into the Fairbanks area is limited to the current stability limit of approximately 85 MW over the single transmission line. Although stability aids could increase this power transfer capability, the amount of power transferred over a single intertie would still be limited to approximately 85 MW as this is considered the maximum allowable import limit into the Fairbanks area to ensure survival following the N-1 contingency loss of the intertie.

The proposed transmission line will allow power transfers to increase from the existing limit of approximately 85 MW and will eliminate the loss of load associated with an N-1 contingency and bring the Fairbanks GRETC area into compliance with the planning criteria following the completion of the second transmission line. The proposed route would parallel the existing intertie. A significant portion, but not all of the right-of-way, of the existing intertie will accommodate an additional line. The exact routing and characteristics of the transmission line, along with any associated changes in compensation at the terminals of the line will be determined in future studies. Figure 12-8 presents the proposed new line. If the preferred generation plan includes a Susitna option, this line configuration will change depending on the selected Susitna alternative.

Figure 12-8
Douglas to Healy 230 kV Transmission Line (New Build)

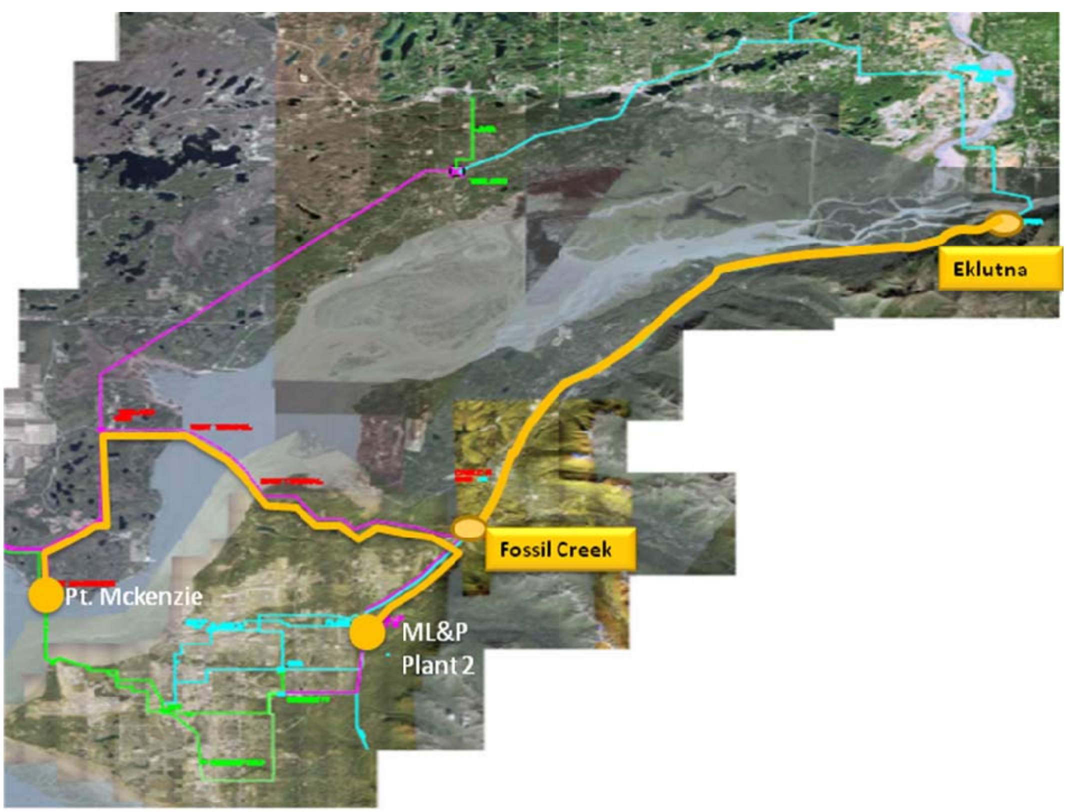


Project H – Eklutna to Fossil Creek 230 kV Transmission Line (Upgrade - Category 2)
The Eklutna and Briggs substations are interconnected by a 230 kV double circuit line with one circuit used to supply multiple MEA distribution substations at 115 kV. The other circuit is not connected to local distribution substations and can function as a direct connection from Eklutna to Fossil Creek. From Fossil Creek the 230 kV line currently connects to the ML&P Plant 2 230 kV substation while the 115 kV line connects to the 115 kV substation at ML&P's Plant 2 generation plant. The construction of a 230 kV/115 kV substation at Fossil Creek would allow this line section to serve an express 115 kV line to Eklutna station while the tapped line would be used to serve local load. As part of the long range goals, the express feeder would be converted to 230 kV with a corresponding 230 kV/115 kV substation at Eklutna. This project, along with upgrade of the MEA 115 kV system (Projects M and N), will be part of a redundant 230 kV path from Beluga to Anchorage. This project includes the construction of a 230 kV/ 115 kV substation at Fossil Creek and Eklutna to serve the MEA 115 kV system. Figure 12-9 presents the proposed line from Eklutna to the Fossil Creek substation.

This project will also require the construction of a 230 kV line section from ML&P Plant 2 to University station for N-1 contingencies at Plant 2 and to support the ML&P and Chugach 138 kV and 115 kV systems as described in other project summaries.

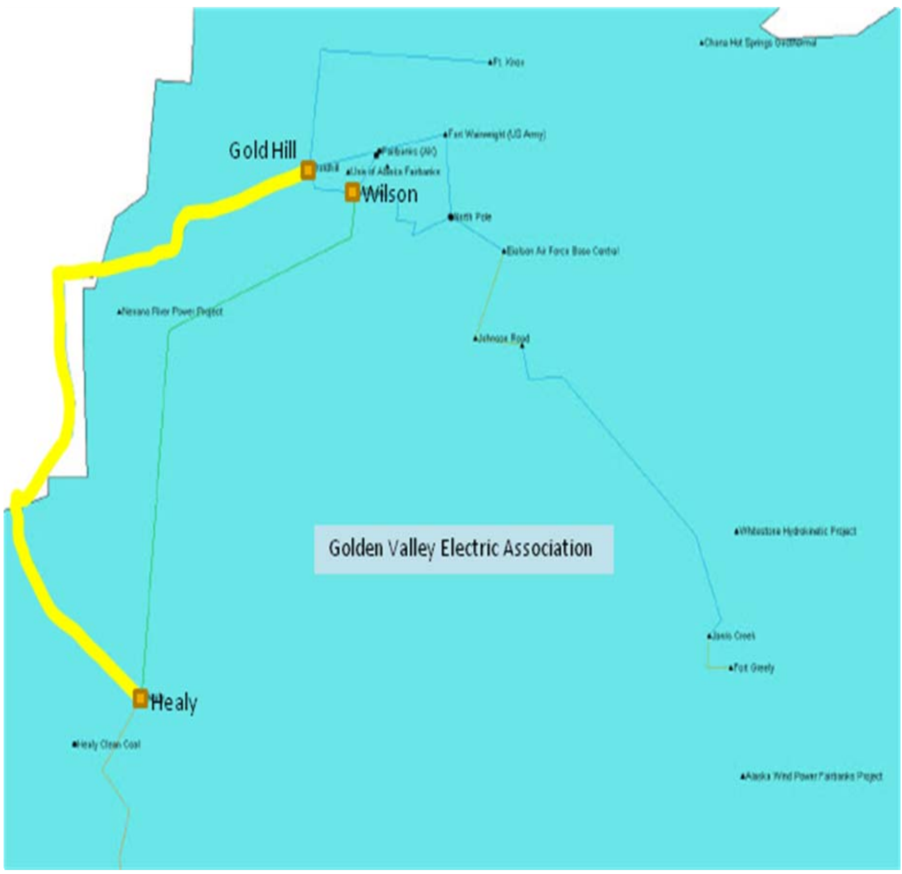
The project may consist of a staged approach resulting in the 115 kV systems in the MEA area continuing to operate at 115 kV for many years while the infrastructure continues to develop.

Figure 12-9
Eklutna to Fossil Creek 230 kV Transmission Line (Upgrade)



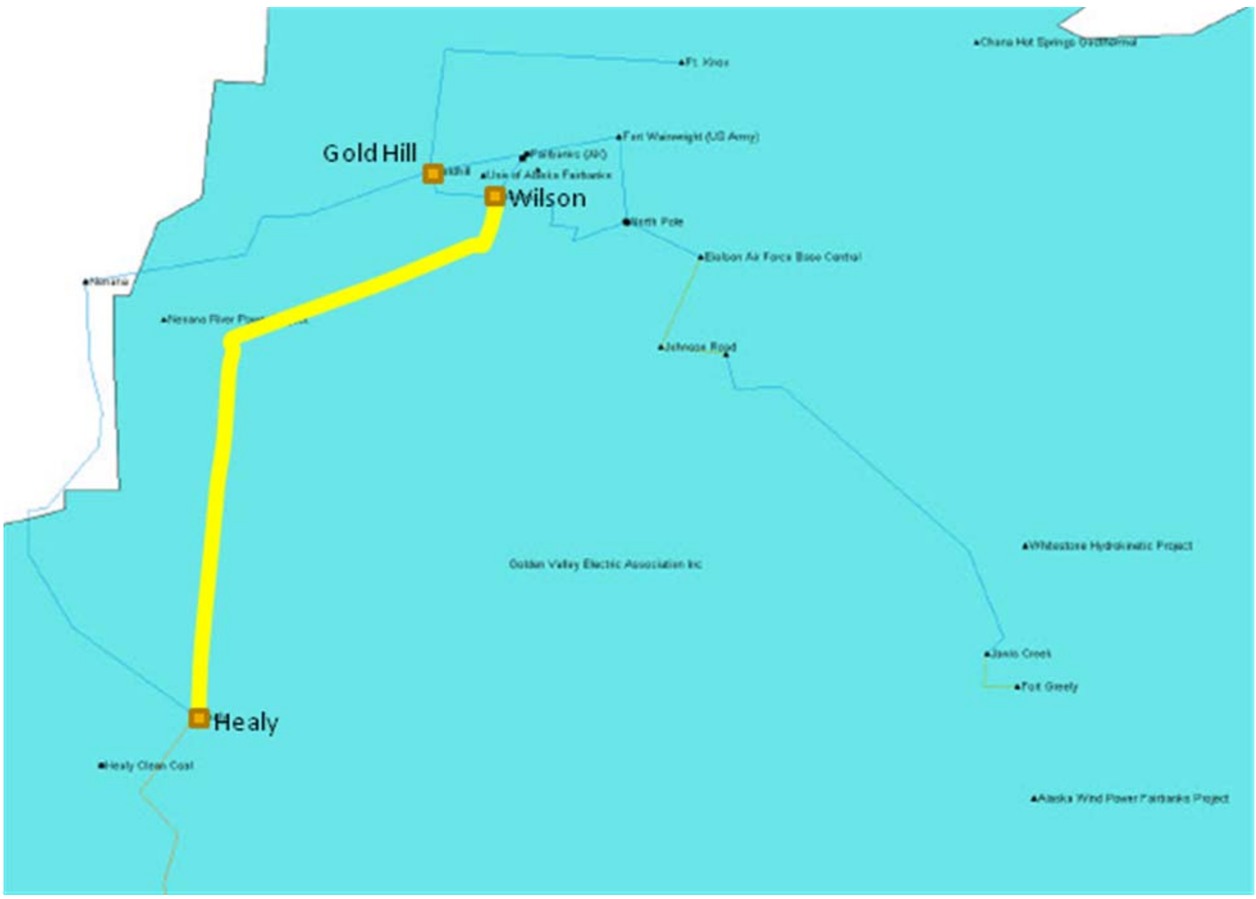
Project I – Healy to Gold Hill 230 kV Transmission Line (Repair and Replacement - Category 1)
The existing Healy to Gold Hill 138 kV line was constructed and placed in service in 1968. This line serves as one of two paths between Healy and Fairbanks and delivers firm and economy power to Fairbanks from the Healy, Anchorage, and Kenai areas. In 2007, the GVEA Long Range Planning Study recommended that this line be rebuilt in stages between 2017 and 2021. The study further recommended that this line should be upgraded to 230 kV although it would initially be operated at 138 kV. When the transmission plan is completed, the existing 138 kV line becomes the weak link in the transmission system and limits the ability to import power into Fairbanks following the N-1 loss of the Northern Intertie. This project is required to meet the GRETC concept of providing a reliable transmission system backbone throughout the Railbelt.
Figure 12-10 presents the proposed upgrade.

Figure 12-10
Healy to Gold Hill 230 kV Transmission Line (Repair and Replacement)



Project J – Healy to Wilson 230 kV Transmission Line (Upgrade - Category 2)
The existing Healy to Wilson line was constructed in 2005 at 230 kV and presently operated at 138 kV. To increase the power transfer capability of the transmission system above its current limits, the line is required to be operated at 230 kV. Operation of this line along with the Healy to Gold Hill line at 230 kV is a part of the phased development of a reliable 230 kV backbone of transmission facilities. Figure 12-11 presents the proposed upgrade.

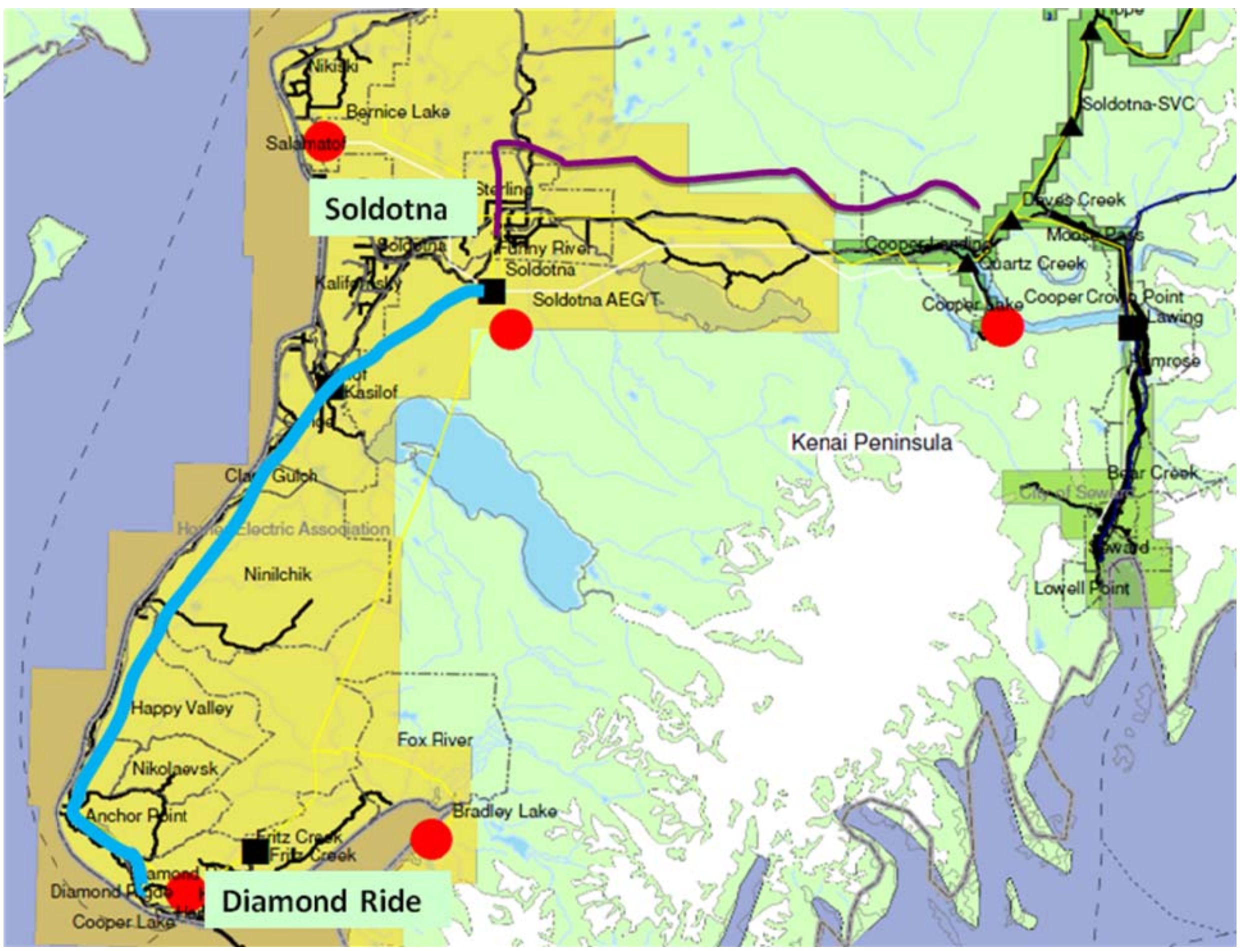
Figure 12-11
Healy to Wilson 230 kV Transmission Line (Upgrade)



Project K – Soldotna to Diamond Ridge 115 kV Transmission Line (Repair and Replacement - Category 1)

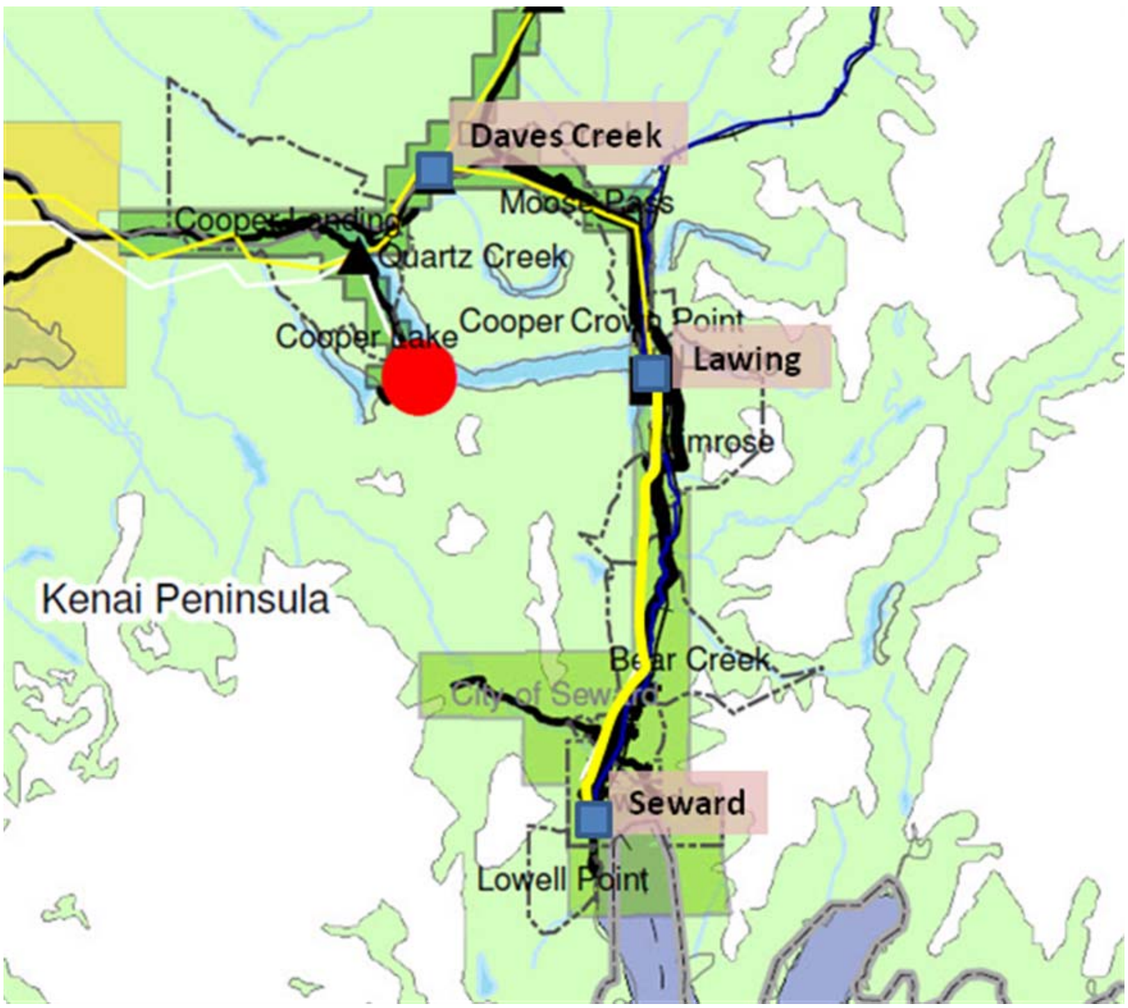
The Soldotna to Diamond Ridge 115 kV line serves several distribution substations on the Kenai from Ski Hill, Kasilof, Anchor Point, Diamond Ridge, and Fritz Creek and as part of a transmission loop from Soldotna Substation to Bradley Lake generation facility. The older of the two lines comprising the transmission loop is in poor condition and has a very small conductor size. The small conductor size on this line segment results in high impedance, high losses and limited capacity transfer over the line. Outage of the express Soldotna to Bradley Lake 115 kV line results in low voltages and line overloads in the southern Kenai and restricts the Bradley Lake project to an output of less than 60 MW in summer months. This proposed project will rebuild the line with larger conductor at the existing transmission line voltage. Figure 12-12 presents the proposed upgrade.

Figure 12-12
Soldotna to Diamond Ridge 115 kV Transmission Line (Repair and Replacement)



Project L – Lawing to Seward 115 kV Transmission Line (Upgrade - Category 1)
The City of Seward is served by a 115 kV line from Daves Creek on the Kenai to the Lawing substation. The voltage is then stepped down to 69 kV and the line continues into the City of Seward. Most of the 69 kV line section was replaced and upgraded to 115 kV insulation, but left to operate at 69 kV. Some distribution stations and the short line to Spring Creek will need to be converted from 69 kV to 115 kV. The transmission line runs primarily through the Department of Forestry lands with sections along the Alaska Railroad. The City of Seward is a full-requirements customer of Chugach and has a winter peak load of approximately 10 MW. Figure 12-13 presents the proposed upgrade.

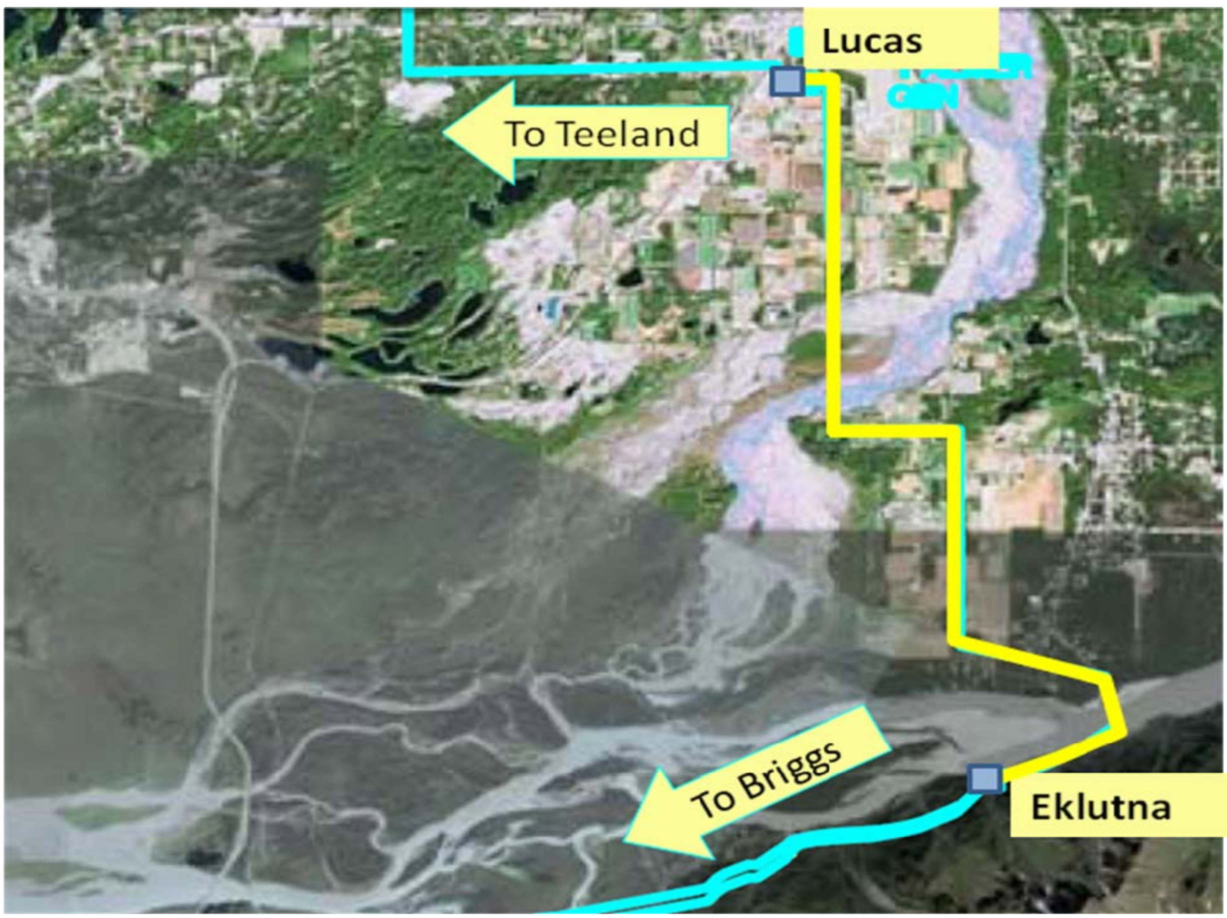
Figure 12-13
Lawing to Seward 115 kV Transmission Line (Upgrade)



Project M – Eklutna to Lucas (Hospital Substation) 115 kV/ 230 kV Transmission Line (Repair and Replacement - Category 1)

The existing Eklutna to Lucas line was originally built as part of the Eklutna Project in 1955 and needs to be rebuilt due to the age and condition of the line. The line requires upgrading or an additional line to meet the requirements of the system over the life of this plan. The optimal construction of this project should be determined in conjunction with the preferred generation plan. The deficiencies of the system can be addressed in a number of different manners. An express 115 kV line similar to the Briggs–Eklutna line eliminates low voltage conditions and provides reliability improvements to meet the GRETC requirements. The express feeder should be insulated to 230 kV to serve as a possible tie to the Teeland station. Alternatively, the existing line could be rebuilt at 230 kV converting all of the MEA substations to 230 kV, or finally the express feeder could be built and operated at 230 kV with a corresponding 230 kV/115 kV substation in the Lucas or Hospital Sub area. The final configuration of the project should be determined in future studies following determination of the preferred generation plan. Figure 12-14 presents the proposed project.

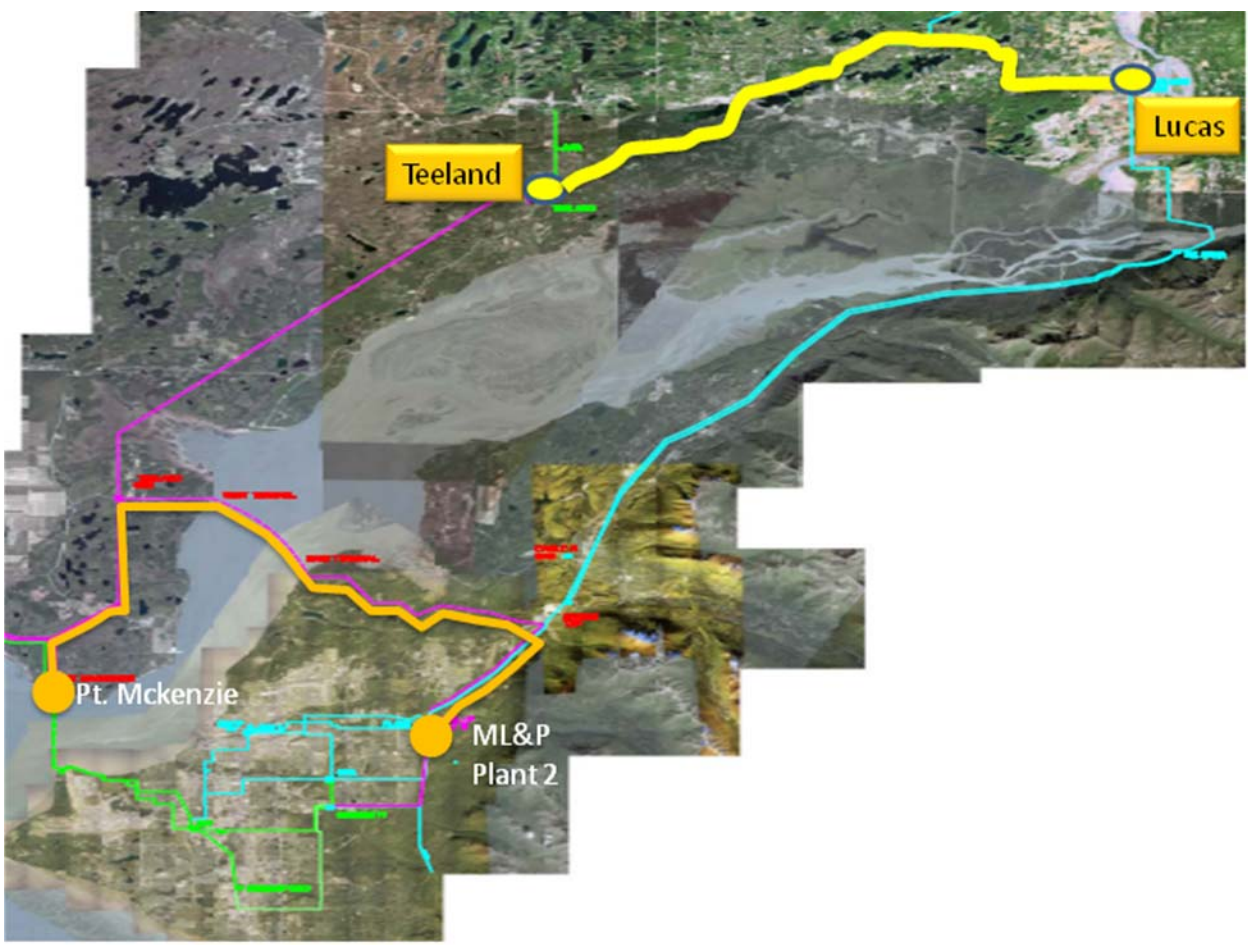
Figure 12-14
Eklutna to Lucas 230 kV Transmission Line (Repair and Replacement)



Project N – Lucas to Teeland 230 kV (115 kV) Transmission Line (Repair and Replacement - Category 2)

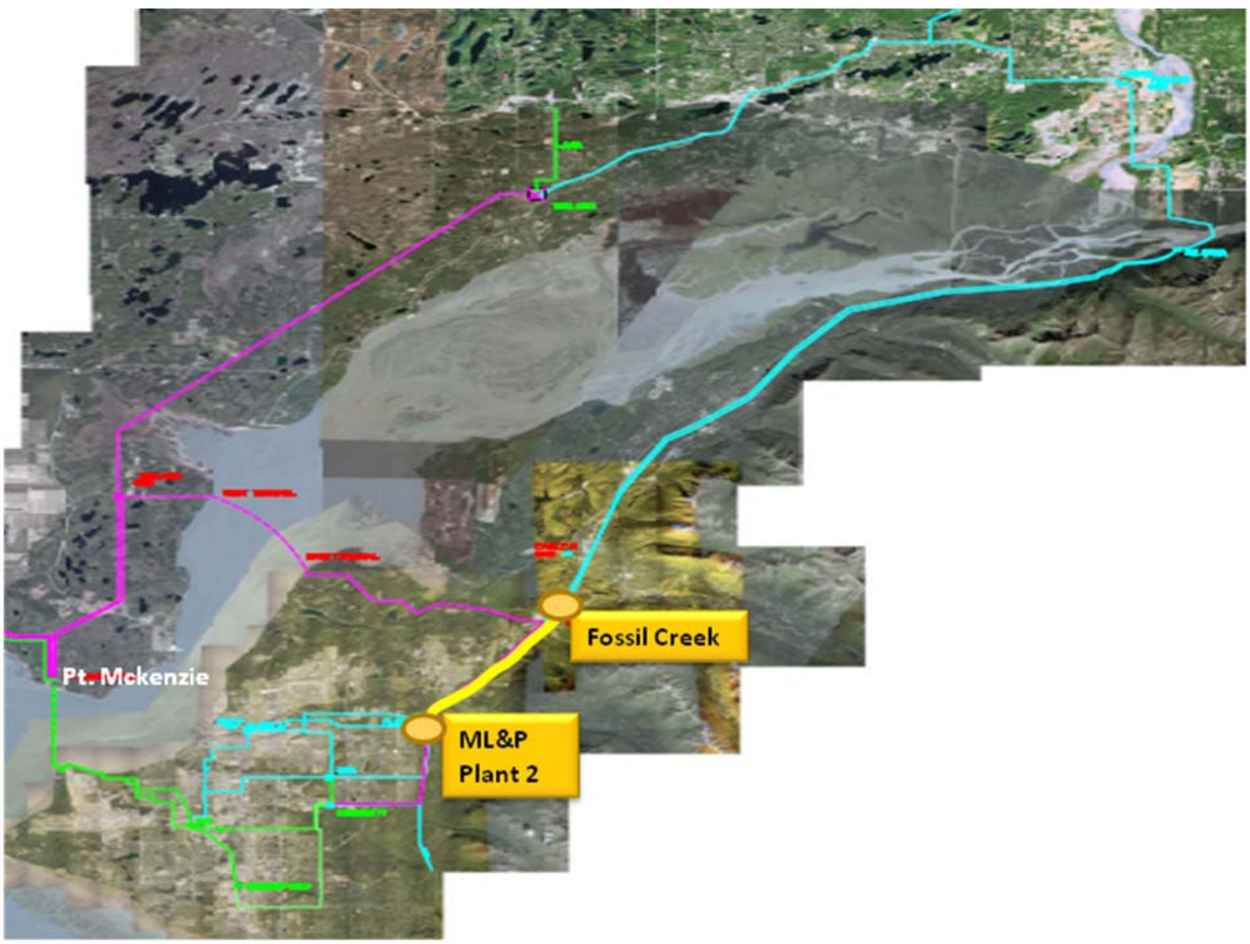
The existing 115 kV Teeland to Lucas line serves several substations in the MEA area. This section of line is subject to low voltages and load loss with the single contingency outage of the Teeland 230 kV/ 115 kV transformer or the Teeland – Pt. MacKenzie 230 kV transmission line. The transmission contingency is alleviated by the construction of Project E (Lake Loraine to Douglas 230 kV line), but the construction of this line does not mitigate the loss of load and low voltage conditions experienced following the loss of the Teeland Transformer. There is currently a 138 kV/115 kV transformer that serves as a emergency replacement for the 230 kV/115 kV transformer, however, this transformer will be retired when the Intertie is converted to 230 kV. In order to alleviate low voltage conditions and loss of load in the MEA area for contingency operations, a new transmission line is required into the Lucas/Hospital Sub area of the MEA territory. The optimum selection of the line and its construction and operating voltage requires more detailed study than is possible in this analysis and will require coordination with other transmission projects and generation alternatives. This project should be evaluated as part of future transmission planning studies. Figure 12-15 presents the proposed replacement.

Figure 12-15
Lucas to Teeland 230 kV Transmission Line (Repair and Replacement)



Project O – Fossil Creek to Plant 2 230 kV Transmission Line (Upgrade - Category 2)
This section of line consists of a double circuit 230 kV constructed line , with one circuit operated at 230 kV and one circuit currently being operated at 115 kV. This project is required to enhance the reliability of the Anchorage and MEA areas. Operation of both circuits at 230 kV will require the construction of a 230 kV/115 kV substation at Fossil Creek and construction of a 230 kV line section from ML&P Plant 2 to University station. Alternatively, it may be possible to install a second transformer at ML&P Plant 2 and increase the transfer capacity of the AML&P 115 kV system. The exact configuration should be determined in future studies. Figure 12-16 presents the proposed upgrade.

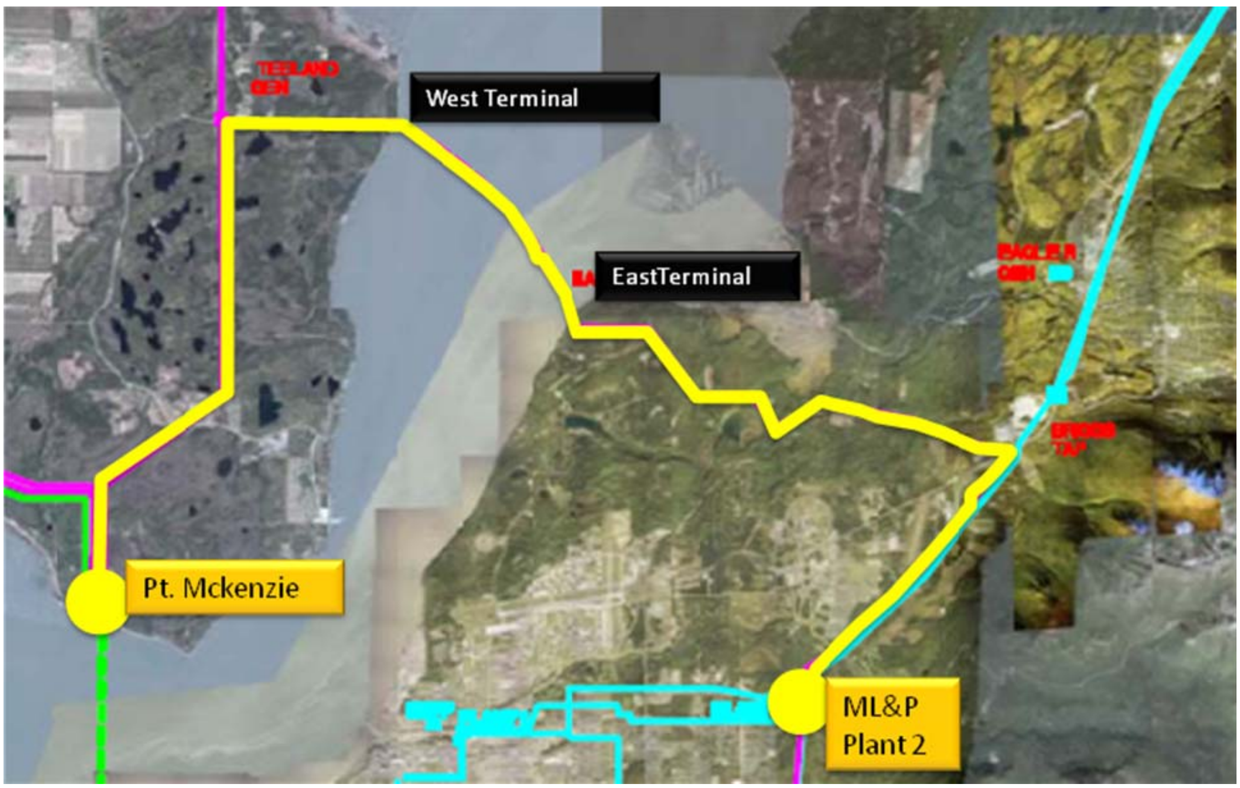
Figure 12-16
Fossil Creek to Plant 2 230 kV Transmission Line (Upgrade)



Project P – Pt. Mackenzie (Lorraine) to Plant 2 230 kV Transmission Line (Repair and Replacement - Category 2)

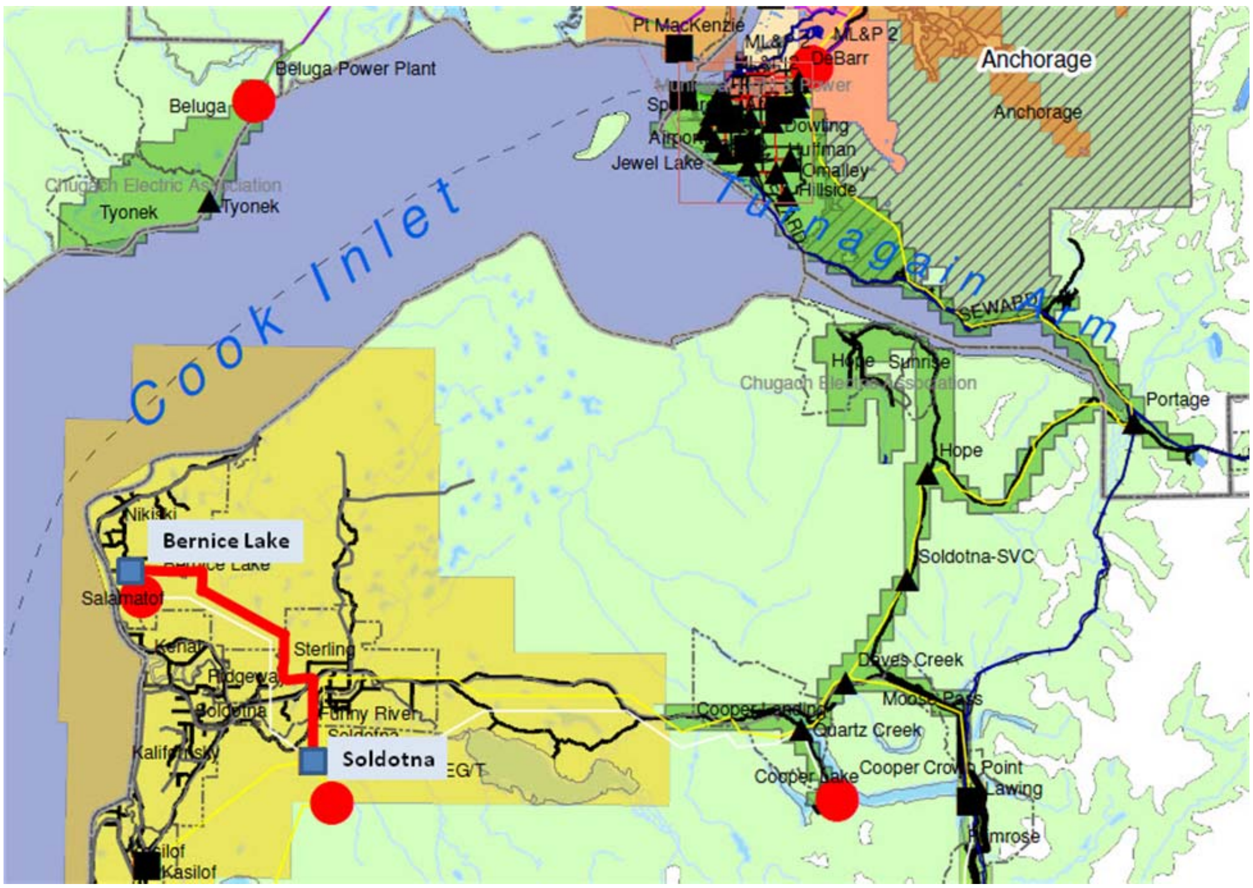
The existing Pt. Mackenzie to Plant 2 transmission line consists of two sections of 230 kV overhead transmission line and a section of underwater cable between the East Terminal and West Terminal stations. The overhead line is in reasonably good condition but the submarine cable is expected to be in need of replacement and repairs by 2025. At that time, the terminus of the transmission line will be Lorraine and AML&P Plant 2 stations. This circuit is critical to the reliability of the Railbelt system and is, therefore, scheduled as a GRETC replacement project. The project is presented in Figure 12-17.

Figure 12-17
Pt. Mackenzie to Plant 2 230 kV Transmission Line (Repair and Replacement)



Project Q – Bernice Lake – Soldotna 115 kV Transmission Line (Rebuild - Category 2)
The 115 kV transmission line from Bernice Lake Power Plant to Soldotna Substation serves as the critical link between the proposed Southern Intertie, the existing Kenai intertie and the Bradley Lake power plant. The transmission line was constructed in 1971 and is expected to require significant reconstruction over the life of this plan. Further study should be undertaken before this line is upgraded to determine if 230 kV operation is required or is possible over the life of this plan. 230 kV operation will require significant permitting and environmental effort and may not be warranted. The project is presented in Figure 12-18.

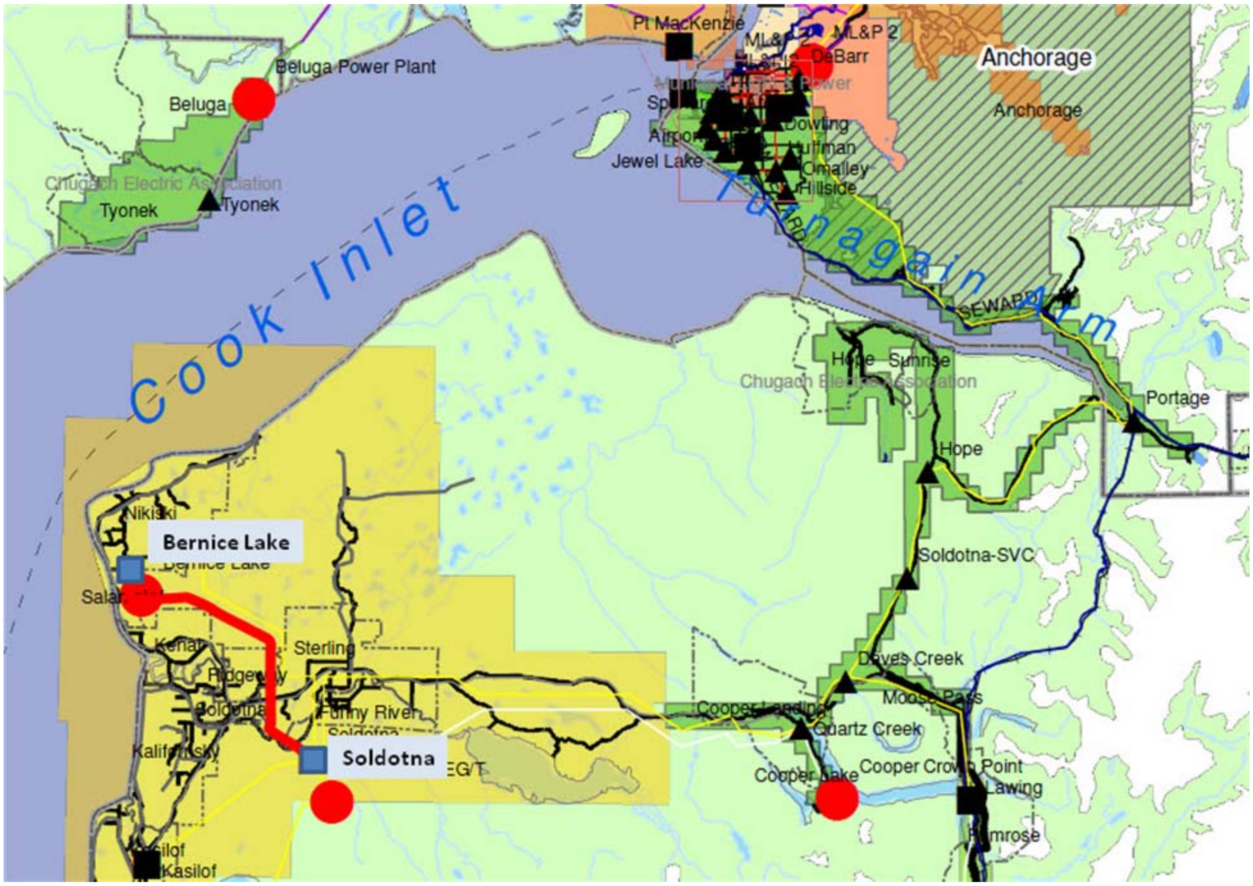
Figure 12-18
Bernice Lake to Soldotna 115 kV Transmission Line (Rebuild)



Project R – Bernice Lake–Beaver Creek - Soldotna 115 kV Transmission Line (Rebuild - Category 2)
The existing 69 kV transmission line between Bernice Lake, Beaver Creek and Soldotna stations cannot be operated in parallel with the 115 kV transmission line between Bernice Lake and Soldotna due to the limited transfer capacity of the line and transient stability limitations. The 69 kV line is required to be upgraded to 115 kV to eliminate the single contingency loss of the existing 115 kV transmission line between Soldotna and Bernice Lake. HEA has rebuilt portions of the 69 kV line to 115 kV construction and Marathon Station is constructed to 115 kV construction.

The project consists of upgrading the remaining portions of the 69 kV line to 115 kV and modifications to the stations at Bernice Lake, Beaver Creek and Soldotna. This line should not be considered for 230 kV operation. The project is presented in Figure 12-19.

Figure 12-19
Bernice Lake to Beaver Creek to Soldotna 115 kV Transmission Line (Rebuild)



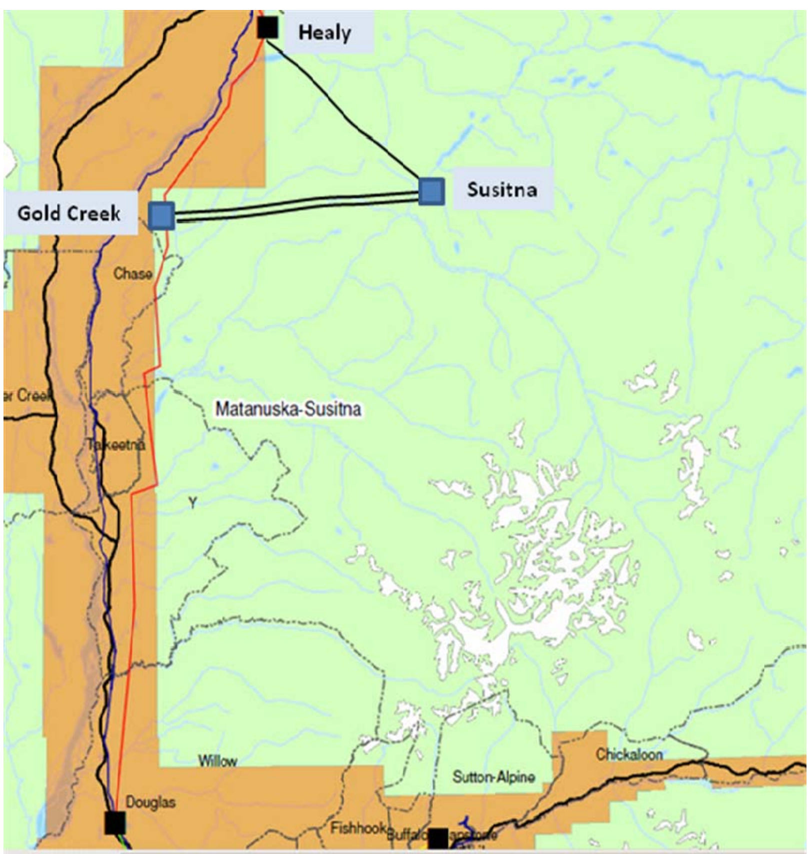
12.6 Susitna

Project S – Susitna Transmission Additions (New Project - Category 3)

The Susitna transmission interconnection configuration will depend on the selected generation site at Susitna. The Watana option consists of two 230 kV transmission lines connecting the Susitna substation to the new 230 kV Gold Creek substation, one transmission line from Sustina to Healy Substation, one additional 230 kV transmission line from the Gold Creek substation south to the Douglas 230 kV substation, and one line 230 kV transmission line from Douglas to Pt. MacKenzie Substation. The Gold Creek substation is approximately 33 miles from the Susitna substation and is the terminating point for the two 230 kV lines from Susitna as well as a switching station for the Douglas to Healy tie lines and the connecting point for the Gold Creek to Douglas 230 kV line that will transport power from the Susitna plant into the southern regions of the Railbelt. The capital cost for the Susitna substation, the two 230 kV transmission lines from Susitna to Gold Creek, and the Gold Creek substation are included in the capital cost for the Susitna projects. The capital cost for the Douglas to Lake Lorraine 230 kV transmission line is included as the incremental cost making the Douglas to Lake Lorraine 230 kV transmission line described in Project E a double circuit line. The Susitna to Gold Creek lines and the Gold Creek to Douglas line are presented in Figure 12-20. The Douglas to Lake Lorraine 230 kV transmission line is shown in Figure 12-6. Project S is not required if the Susitna project is not constructed.

If the Devils Canyon site is selected, three lines between Susitna and Gold Creek are required; however, the second Intertie between Gold Creek and Healy would replace the Susitna-Healy line.

Figure 12-20
Susitna to Gold Creek 230 kV Transmission Line



12.7 Summary of Transmission Projects

The list of transmission projects is presented in Table 12-1, and their locations are shown in Figures 12-21 and 12-22. Table 12-1 also includes preliminary cost estimates for each of the listed projects. Note that this list does not include a description of the associated distribution substations that would need to be upgraded to accommodate the new voltage levels of the transmission projects. The cost of these projects are however included in the total cost for each scenario and is also shown in the table below. While the details of GRETC are not yet developed to a point that determines whether these distribution substations would be a part of the GRETC system or part of the individual utilities distribution systems, they are a necessary cost resulting from the development of the GRETC system and have been included in the economic evaluations. All the transmission projects presented in this section were evaluated by a transmission load flow analysis to determine how the Railbelt system performed with these projects along with the economic dispatch of the selected generating resources in the RIRP.

Table 12-1
Summary of Proposed Transmission Projects

Project No.	Transmission Projects	Type	Cost ($000)
A	Bernice Lake – International	New Build (230 kV)	227,500
B	Soldotna – Quartz Creek	R&R (230 kV)	126,500
C	Quartz Creek – University	R&R (230 kV)	165,000
D	Douglas – Teeland	R&R (230 kV)	62,500
E	Lake Lorraine – Douglas	New Build (230 kV)	80,000
F	Douglas – Healy	Upgrade (230 kV)	30,000
G	Douglas – Healy	New Build (230 kV)	252,000
H	Eklutna – Fossil Creek	Upgrade (230 kV)	65,000
I	Healy – Gold Hill	R&R (230 kV)	180,500
J	Healy – Wilson	Upgrade (230 kV)	32,000
K	Soldotna – Diamond Ridge	R&R (115 kV)	66,000
L	Lawing – Seward	Upgrade (115 kV)	15,450
M	Eklutna – Lucas	R&R(115 kV/230 kV)	12,300
N	Lucas – Teeland	R&R (230 kV)	51,100
O	Fossil Creek – Plant 2	Upgrade (230 kV)	13,650
P	Pt. Mackenzie – Plant 2	R&R (230 kV)	32,400
Q	Bernice Lake – Soldotna	Rebuild (115 kV)	24,000
R	Bernice Lake – Beaver Creek - Soldotna	Rebuild (115 kV)	24,000
S	Susitna Transmission Additions	New Build (230 kV)	57,000

Figure 12-21
Location of Proposed Transmission Projects (Without Susitna)

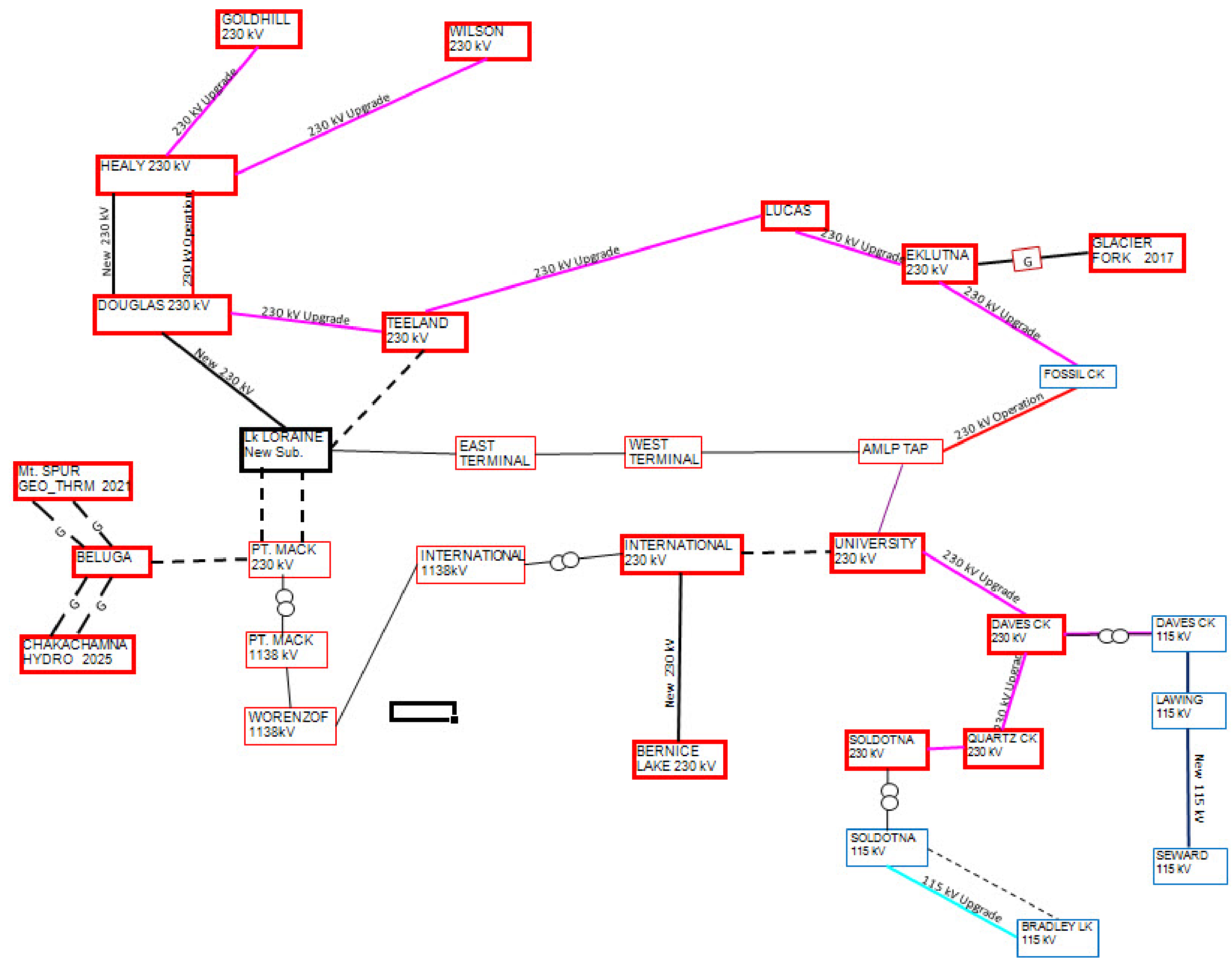
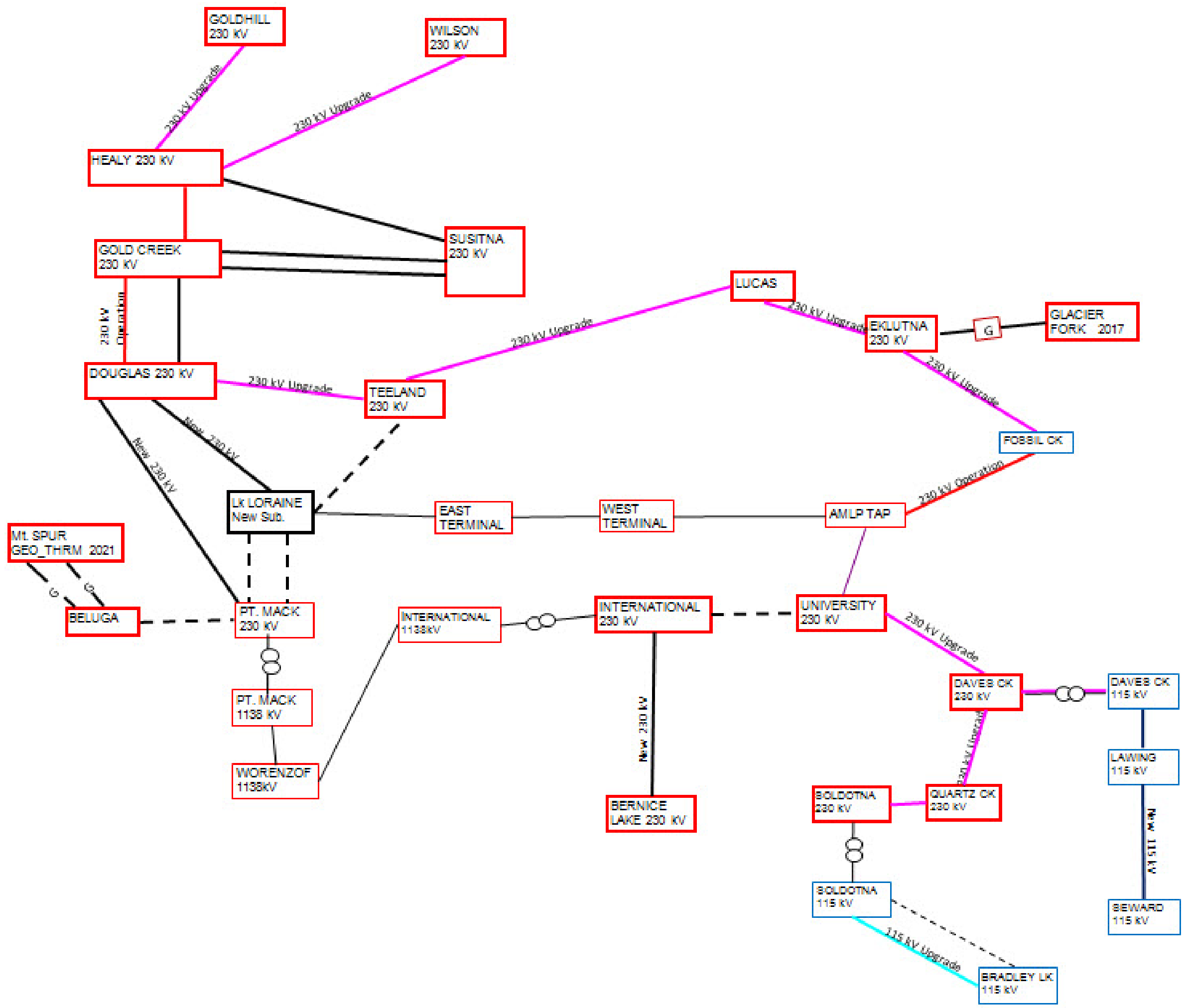


Figure 12-22
Location of Proposed Transmission Projects (With Susitna)



12.8 Other Reliability Projects

In addition to the transmission lines presented in this section, other projects were considered that could contribute to improving the reliability of the Railbelt system. These projects generally fall into one or more of the following categories:

- Providing reactive power (static var compensators – SVCs)
- Providing or assisting with the provision of other ancillary services (regulation and/or spinning reserves)
- Assistance in control of line flows or substation voltages
- Assistance in the transition and coordination of transmission project implementation (mobile transformers or substations)
- Communications and control facilities

Several of these projects have been identified and discussed while others will result from the transmission reliability assessment. Potential projects in this category include:

- Substation capacitor banks
- Series capacitors
- SVCs
- BESS
- Mobile substations that could provide construction flexibility during the implementation phase

Many of the projects listed will be proposed and reviewed during the reliability evaluation phase, while others may be identified only when more detailed design and specification of the transmission projects are undertaken. Where preliminary information indicates that these projects will be required as part of the projects identified above, their estimated costs have been included in the project cost in Table 12-1. The cost for any additional projects will be developed during the reliability analysis conducted as part of the implementation.

The Railbelt system currently has several SVCs deployed across the system to assist in the operation of the system and to assist in the stable transfer of power between areas. These were installed several years ago and are considered critical to the stable operation of the system. Further analysis of the projects outlined in Section 12.5 is expected to result in potential changes to these projects, as well as a requirement for several more SVCs at locations to be identified by the stability analysis. Additionally, the currently deployed SVCs are in need of repairs if they are to continue in service and provide the reliability functions they were designed to provide. It is estimated that the repair or replacement of these existing SVCs would cost a total of approximately $25 million.

Projects that could facilitate or complement the implementation of other projects (e.g., wind) were of particular interest during project discussions. These projects, if implemented, could smooth the transition and adoption by the utilities of the GRETC concept. One such project was the BESS that could provide much needed frequency regulation and potentially some spinning reserves when non dispatchable projects, such as wind, are considered. Specific stability and regulation studies will be required to determine the best methods of integrating the wind generation.

A BESS was specified that could provide frequency regulation required by the system when wind projects were selected by the RIRP. The BESS was sized in relation to the size of the non-dispatchable project to be 50 percent of the project nominal capacity for a 20-minute duration. For evaluation purposes, a 27 MW BESS which would provide 50 percent of 54 MW Fire Island project is estimated to cost approximately $50 million. Although the performance of the BESS has not yet been analyzed as part of the stability analysis, the cost for the system was included in the analysis in Section 13. Other options (e.g., fly wheel storage technologies and compressed air energy storage) that could provide the required frequency regulation should also be considered.

It should be noted that if the need for frequency regulation is driven in part by an IPP-sponsored renewable project, policies will need to be adopted to allocate an appropriate portion of the regulation costs to those projects.

The GRETC system will require upgrades to the communication and control systems of the existing facilities in order to operate as a unified grid. Communication for pilot relaying between Anchorage and Fairbanks as well as communication upgrades to the Anchorage – Kenai system will be required for protective relaying and control. The individual utilities have their own communication and control systems. The alternatives and costs for implementing the necessary communication and control systems for GRETC operation were discussed in the REGA study. Those costs which are considered necessary administrative costs for implementing GRETC are not included in the costs in Table 12-1.

12.9 Projects Priorities

The proposed projects presented in Section 12.5 are not presented in any specific order or priority. It was felt that the information currently available, as well as the uncertainty which exists surrounding the selected generation plans, did not permit a more definitive prioritization of projects. This does not mean, however, that all the projects in the list have the same impact on the reliability of the Railbelt system, or that the projects are equally important to each utility. In several instances the projects were in extremely poor physical condition and were scheduled to be repaired or rebuilt to prevent the lines from literally falling to the ground. To facilitate the immediate repairs to these lines, the projects that should be addressed within the next five years because of their potential impact on the reliability of the system have been identified. Additionally, some of the projects will need to be evaluated and specified further and funds have been identified to facilitate the studies that are required to further identify and schedule the transmission improvements that will be required.

The following projects and studies have been identified for priority attention because of their immediate impact on the reliability of the existing system. All of the projects will require detailed system feasibility studies prior to actual implementation. Estimated costs for these studies are included as part of the project costs estimates in Table 12-1. The following projects are estimated to be required within the next five years.

1. Soldotna to Quartz Creek Transmission Line ($126.5 million – Project B)
2. Quartz Creek to University Transmission Line ($165.0 million – Project C)
3. Douglas to Teeland Transmission Line ($62.5 million – Project D)
4. Lake Lorraine to Douglas Transmission Line ($80.0 million – Project E)
5. SVCs ($25.0 million - Other Reliability Projects)
6. Funds to undertake the study of the Southern Intertie ($1.0 million)
7. Funds to investigate the provision of regulation that will facilitate the integration of renewable energy projects into the Railbelt system ($50.0 million, including cost of BESS – Other Reliability Projects)

The total estimate costs necessary for transmission projects during the initial five years of the RIRP is $510 million in 2009 dollars.