4.0 ENGINEERING DESIGN, CONSTRUCTION, AND RIGHT-OF-WAY ACQUISITION

4.1 Transmission Line Engineering and Operational Design

4.1.1 Transmission Structure Design and Right-of-Way

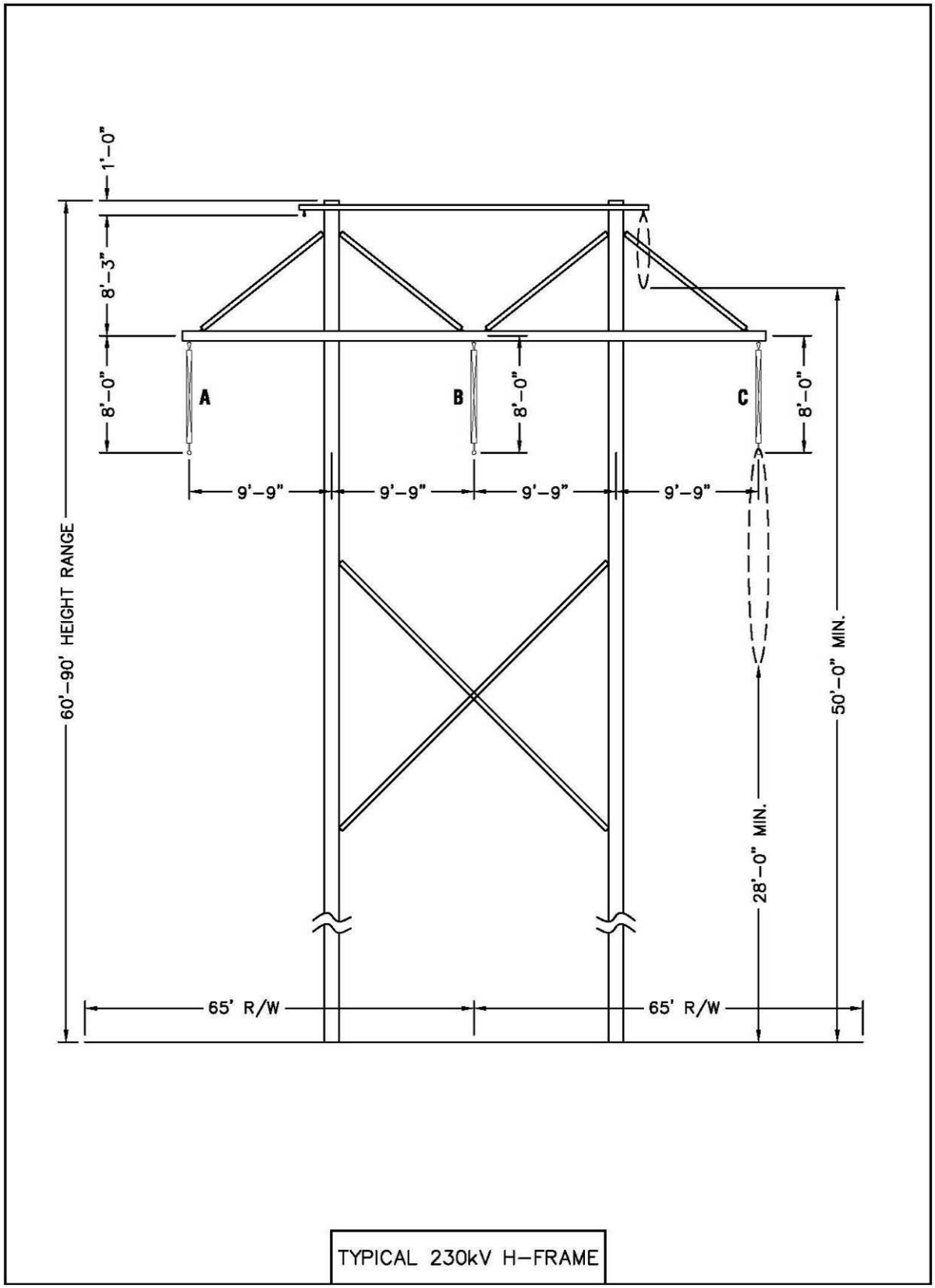
The Applicants propose to construct single-circuit portions of the transmission lines using predominantly H-frame 230 kV structures (see Drawing 4-1 and Appendix C) embedded in holes augured to a depth of approximately 10 to 15 feet. The H-frame's poles would be set approximately 19.5 feet apart in the augured holes, which would then be backfilled with native soils or granular material. H-frame structures are suitable for single-circuit construction in rugged terrain, and for areas requiring longer spans to avoid or minimize the placement of structures in wetlands or waterways. Each H-frame would range in height from approximately 60 to 90 feet and be placed approximately 600 to 1,000 feet apart. Corner structures would be direct embedded with guy wires, or if needed would be on reinforced concrete drilled shaft foundations depending on soil types and route angles. Either multiple or single pole structures may be used as angle structures.

The Applicants propose to use single-pole self-supporting structures set on reinforced concrete drilled shaft foundations for double-circuit portions of the transmission line. Single-pole self-supporting structures may also be used for single-circuit portions of the transmission line in areas where the available width of the right-of-way is limited by existing infrastructure or development. The height of single-pole single-circuit structures would range from approximately 70 to 100 feet, with the span between structures approximately 400 to 800 feet apart. Double-circuit single pole structures would range in height from approximately 95 to 115 feet with the span between structures approximately 350 to 700 feet.

General construction procedures are discussed in Section 6.12.1. Final decisions on structure types, locations, and construction methodology would be made during final design.

For each of the three phases of the 230 kV transmission lines, the Applicants propose a single 1590 kcmil (thousand circular mil) or 954 thousand circular mil (kcmil) aluminum conductor steel reinforced (ACSR) conductor. The Applicants propose to use 3/8-inch diameter extra high strength steel (EHS) and fiber optic ground wire (OPGW) for the shield wires. Conductor size and shield wire selection are subject to change pending completion of additional electrical optimization studies. The typical right-of-way width for each 230 kV line would be 130 feet wide.

Drawing 4-1: Typical 230 kV H-Frame



4.1.2 Design Options to Accommodate Future Expansion

The installation and operation of the four proposed single-circuit 230 kV transmission lines would be adequate to serve the planned ESM taconite plant, DRI and steel slab facility. Therefore, there are no plans to design and construct any of the four transmission lines to accommodate future double-circuit capability or to operate at a higher voltage. The Shannon to Essar Steel Plant Substation, Boswell to Essar Mine Substation and Essar Mine Substation to Essar Steel Plant Substation 230 kV circuits are planned to have 1590 kcmil ACSR conductors to match the electrical performance of the 94 Line. The Blackberry to Essar Steel Plant Substation is planned to have 954 kcmil ACSR conductor. Conductor size is subject to change pending completion of additional electrical optimization studies.

Double-circuiting

There are some locations with opportunity for double-circuiting with existing 115 kV transmission lines. Environmental issues, system reliability, construction, and maintenance cost factors must be evaluated when considering the double-circuiting option. A double-circuit design:

- would require less right-of-way than two parallel single-circuit lines,
- may result in less environmental impact,
- has reliability issues, since a single incident (such as high winds, tornado or lightning) could take out both lines on a common structure,
- is more costly; construction of a double circuit 230/115 kV line costs more than constructing a new 230 kV single-circuit line parallel to an existing 115 kV line,
- has maintenance and operational issues; additional operational precautions may be required when performing planned and/or emergency maintenance on a double-circuit line.

Placing two of the 230 kV circuits supplying ESM on the same structure or within the same right-of-way increases the probability that a single event, as discussed above, could result in a simultaneous outage of two of the three 230 kV circuits supplying electric power to the ESM Project. These three electric supply lines consist of the 230 kV lines connecting the ESM Project to the Boswell, Shannon, and Blackberry substations. Studies have indicated that a disturbance resulting in the simultaneous loss of two of these 230 kV supply circuits would result in outages to the steel plant. Because of this impact on the reliability and security of the electric supply to ESM, the Applicants prefer route alternatives that do not result in placement of any two of the proposed 230 kV lines on common structures or common rights-of-way.

A number of the segments follow existing 115 kV lines for portions of their length. Table 4-1 identifies the potential double-circuiting opportunities where existing homes, buildings or other physical facilities may constrain safe, reliable structure installation and operation. As explained above, due to reliability and post contingency stability concerns, double circuiting of any two of the Project's 230 kV lines is not a viable alternative for any of the routes.

Table 4-1: Potential Double-Circuiting Opportunities

Segment	Description	Length of Double-Circuit (230/115 kV)	Owner	Route	Map Reference
28	Houses at intersection with Reilly Beach Road	1,000 feet	MP – 115 kV line	2	Appendix A.5
118/88	Houses at intersection with CSAH 7	1,000 feet	MP – 115 kV line	2	Appendix A.5
8/9	Narrow area between Big and Little Sucker Lakes	1,500 feet	MP – proposed re-routed 115 kV line	4A	Appendix A.6
34	Houses at intersection with CSAH 12	1,500 feet	MP – 115 kV line	3	Appendix A.8
34	Housing development in Pengilly	6,000 feet	MP – 115 kV line	3	Appendix A.11

Undergrounding

Installing a new transmission line underground by directional boring and/or open trenching raises environmental and electric reliability concerns. The significant additional construction costs of an underground line must also be taken into consideration when assessing the feasibility of undergrounding a high voltage transmission line. An underground 230 kV transmission line would cost more than ten times the cost of a comparably rated 230 kV overhead transmission line.

An underground option would involve construction of a transition station at each end to connect the underground conductor with the overhead conductors. Typically, fenced areas around these sites would be approximately 80 feet by 100 feet. The sites are essentially small switching stations or substations consisting of dead-end towers, risers, insulators, switches, and surge arresters. If high-pressure oil-filled pipe-type cable is used, the sites would be larger and include pressurizing plants, oil storage tanks, and associated oil management equipment. There also would be a need to run a distribution power supply, as well as alarm and control circuits, to the two transition stations. In addition, utility personnel would need to visit the site at least monthly for maintenance, requiring a permanent access road to each of the two transition stations.

Repair and restoration of a faulted cable can take several weeks or significantly longer, depending on access. For extruded-dielectric cable, repair requires replacement of the entire cable between the splice points. Consequently, access to manholes along the full length of the underground line must be possible during all seasons of the year. Repair would require locating the fault and replacing the faulted cable between the manhole access points, which are generally 1,500 to 2,000 feet apart. Heavy equipment would be brought to the site, including cable reels, which weigh in excess of 30,000 pounds. The failed cable would be pulled out, and new cable installed into the duct between manholes.

These activities would result in impacts to the adjacent land surfaces, including wetlands and forestlands, if present. If a year-round road were not maintained for access, repair of a faulted cable would be delayed until matting was brought in to allow access for the heavy equipment in wetland areas.

Installing cable in cold ambient conditions is not recommended because it can damage the cable. For this reason, a fault that occurred during the winter would also require the installation of temporary cable warming huts where the cable would be warmed for several days before being installed. This would further delay restoration of service.

Installation of an underground transmission line would also have a direct impact on electric reliability and security. This is not only due to the time required to repair a faulted cable, but also due to cable operational issues. For example, reclosing (re-energizing) an underground circuit after a transmission fault is not recommended until it is verified that the fault is not in the cable. This is because reenergizing a faulted cable can result in the explosion of gaseous byproducts from the fault. Because of this, outages that would typically be only momentary events lasting less than a tenth of a second on an overhead line would increase in length to several hours while it is verified that the fault was not in the underground portion of the line.

The operation and maintenance requirements for an underground line would unfavorably affect the reliability and security of the transmission system in the area. In light of this and the environmental impacts associated with the installation, maintenance, and repair of underground cable, the Applicants prefer an overhead rather than an underground transmission line.

Use of Existing Utility and Public Rights-of-Way

The use of existing utility and public rights-of-way was considered in selection of routes for the Project. The Applicants may be able to decrease the impacts of the new transmission lines by sharing rights-of-way of existing facilities. Table 4-2 provides a summary of the right-of-way sharing options along the routes.

Table 4-2: Summary of Right-of-Way Sharing Along Routes (Miles)

Route	Route Length	Adjacent Right-of-Way Type					Total Length Shared	% of Length Shared
		Transmission Line	Road	Railroad	Pipeline	None		
1	7.5	0	0	0	0	7.5	0	0
1A	9.3	0	0.9	0	0	8.4	0.9	10
2	10.7	8.4	0	0	0	2.3	8.4	79
2A	9.7	0	2.3	0	0	7.4	2.3	24
3	14.4	11.4[a]	0.3	0	0	2.7	11.7	81
3A	18.5	8.6	0	0	0.8	6.2	9.4	51
4	2.8	0	1.4[b]	0	0	1.5	1.4	50
4A	3.1	0	1.1	0	0	2.0	1.1	35

[a] *2.4 miles of this transmission right-of-way is also shared with existing railroad*

[b] *1.1 miles of this represents a proposed ESM road alignment*

4.2 Right-of-Way Acquisition, Construction, Restoration and Maintenance Procedures

4.2.1 Right-of-Way Acquisition

Following issuance of the Route Permit, the Applicants would begin the process of acquiring easements for the construction, operation, and maintenance of the new transmission lines. The right-of-way agent would complete a search of the public records of all lands involved in the Project. A title report would be

developed to determine the legal description of the property, the owner(s) of record of the property, and information regarding easements, liens, restrictions, encumbrances, and other conditions of record. The landowners would have been notified of the Project due to the public notices published, and public information meeting held by the Applicants and public meetings held during the State environmental review and permitting processes.

Once the property owners along the approved routes have been identified, a right-of-way agent would inform them of the construction of the transmission lines and how it may affect their property. With property owner's permission, survey crews would enter the property to complete the preliminary survey work and possibly conduct soil investigations for structure location. As the design of the transmission lines near completion, the survey crews would stake the structure locations.

During the acquisition process, the property on which easement rights are required would be evaluated by the agent to determine the amount of just compensation. In the event that a complicated appraisal problem arises, or if a statutory requirement in the local jurisdiction dictates, the right-of-way agent would arrange for an appraisal to determine the value of the rights being acquired.

The right-of-way agent would begin the negotiating process by presenting the required legal documents to the property owner. Property owners would also be provided maps of the transmission line route showing the landowner's parcel. The offer of compensation for an easement would be explained as requested; the landowner would be allowed a reasonable amount of time in which to consider the offer, obtain an appraisal, and present information the owner believes is relevant to determining the value of the property.

The agent would work closely with all the landowners to try to arrive at a negotiated settlement that is fair and acceptable to all parties. In most cases, right-of-way agents are able to work with the landowners to address their concerns.

In some cases, a negotiated settlement is not possible and the Applicants may choose to obtain the right-of-way by exercising their right of eminent domain (condemnation). Condemnation proceedings would only be initiated by the Applicants if reasonable efforts to negotiate an agreement at what is believed to be just compensation have failed.

There also may be instances where property is purchased by the Applicants pursuant to Minn. Stat. § 216E.12, subd. 4 (sometimes referred to as the "buy the farm" provision). This provision provides that under certain circumstances, the property owner may require the Applicants to purchase the owner's contiguous property if the transmission line crosses a portion of the property. If the statutorily required special circumstances exist, this option may be chosen at the landowner's discretion.

4.2.2 Construction Procedures

Transmission Line

Once access to the land is granted, preparation of the right-of-way for construction begins in coordination with landowners. Underground utilities would be identified and located in cooperation with local utility companies to minimize conflicts to the existing utilities along the routes. Preparation for construction begins with development of access points from existing roads. Clearing of all woody vegetation and brush within the 130-foot-wide right-of-way would be required to facilitate the safe and efficient construction, operation, and maintenance of the transmission line. A reasonably level access path is required to provide for safe passage of construction equipment. At structure locations, a stable working surface free of tripping hazards is required for framing and erecting structures, and for the installation of concrete foundations if required.

Vegetation would be cut at or slightly above the ground surface. Rootstock would be left in place to stabilize existing soils and to regenerate vegetation after construction. With the approval of the landowner or land manager, stumps of tall-growing species would be treated with an approved herbicide to discourage re-growth. Merchantable timber is typically cut to standard log lengths and stacked along the right-of-way edge. Vegetation clearing debris (unmerchantable trees, brush, and slash) may be cut and scattered, placed in windrow piles, chipped or burned, depending on location. In some special circumstances, this material may be collected for use as fuel.

To minimize the potential for tire and chassis damage to construction equipment, and to maintain a safe, level access path and structure installation area, incidental stump removal would occur. Stumps that interfere with the placement of mats or movement of construction equipment would be ground down to a point at or slightly below ground level. The stump grinding equipment would mix woody material with soils. This mixture would be evenly spread near the stump to a depth that would allow existing low-growing vegetation to re-establish.

If temporary removal or relocation of fences were necessary, the installation of temporary or permanent gates would be coordinated with the landowner. The right-of-way agent would also work with landowners for early harvest of crops, where possible. During the construction process, the Applicants may ask the property owner to remove or relocate equipment and livestock from the right-of-way.

Transmission line structures are generally designed for installation at existing grades. However, if vehicles or installation equipment cannot safely access or operate near the structure, minor grading of the immediate terrain would be performed to provide a reasonable level working surface for construction and maintenance of the structure.

Environmentally sensitive areas or areas susceptible to soil erosion would require special construction techniques. These techniques may include the use of low ground pressure equipment, timber mats, terracing, water bars, bale checks, rock checks, or temporary mulching and seeding of disturbed areas exposed during long periods of construction inactivity. Permanent erosion control measures may include permanent seeding, mulching, erosion control mats, or other measures depending on site conditions. Temporary bio-roll, silt fence, sedimentation ponds, and other measures may be utilized to prevent sediment from running off into wetlands or other surface waters.

Construction equipment would be inspected frequently to ensure hydraulic systems and oil pans are in good condition and free of significant leaks. Portable spill containment kits would be required for each piece of construction equipment with the potential to discharge a significant amount of oil to the environment. Operators would be present at the nozzle at all times when refueling is in progress. In the event of a spill, the source of the spill would be identified and contained immediately upon discovery. The spill and contaminated soils would be collected, treated, and disposed of in accordance with all applicable federal, State, and local requirements. If a significant spill were to occur to surface waters, methods to contain and recover released material such as floating booms and skimmer pumps would be used. Noticeably contaminated soils would be excavated and placed on and covered by plastic sheeting in bermed areas. An emergency response contractor would be secured, if necessary, to further contain and clean up a severe spill. Refueling of equipment in wetlands would not be permitted.

In the event that protected species or cultural and historical artifacts are encountered during construction activities, Project management personnel would consult with regulatory authorities regarding appropriate construction procedures and mitigation measures.

Construction materials would be hauled either directly from the local highway or railroad network to structure sites, or brought first to material staging areas and then to the structure sites. The transmission

line components, including the poles, arms, and hardware, are normally brought to the temporary staging areas on flatbed trucks. These materials are stored until needed and then loaded on flatbed trailers or special pole trailers for delivery to the structure site where they are unloaded for installation.

A stable working surface is required at structure locations. Timber mats are commonly used to provide a working surface in unstable soils. Structures are normally assembled on the ground along with insulator assemblies and single-leader "p-line" ropes and then raised into position. For direct embedment type structures, the poles are set in augered holes with large rubber-tired or tracked cranes. The annular space between the pole and the augered hole is backfilled with native soils if suitable or with granular materials.

Where reinforced concrete foundations are required, large rubber tired or track mounted auger equipment is used to excavate a circular hole of the appropriate diameter and depth. In upland areas, excavated material would be spread evenly around the structure base to promote site drainage. Reinforcing steel and anchor bolts are set in position. Ready-mixed concrete is then placed in the excavation. In wetland areas, a telescoping temporary steel caisson would be placed in the foundation hole to stabilize the soil walls. Concrete is placed in the excavation using the direct chute method in dry holes or the tremie method in wet holes. Water pumped from the excavation would be pumped to adjacent upland areas or placed into tanker trucks or empty concrete trucks and hauled away to a specially designated upland disposal area, or brought back to the concrete batch plant for discharge. Concrete truck washwater would be discharged only in specially designated upland disposal areas or at the concrete batch plant.

After the concrete is poured, the steel caisson is removed. In some situations, a permanent caisson may be required to stabilize the excavation. During drilling, a minimal amount of granular material (from an outside source) would be placed in the area between the caissons and the drilled hole and timber mats (if required at that location) to provide safe footing for construction personnel and to maintain the footing plumb. During final restoration, the granular material is leveled or removed to restore the original ground contours for re-vegetation of native species. After the foundation concrete is placed, excess excavated materials would be transported to a suitable upland site by truck for disposal. After allowing adequate curing time, the steel pole structure base plates are bolted to the concrete foundations.

The wire stringing process starts in a setup area prepared to accommodate the stringing equipment and materials, normally located mid-span on the centerline of the right-of-way. The rope machine, new conductor wire trailers, and tensioner are located at the wire stringing set-up area. This phase of construction occurs after the structures have been erected, and fitted with stringing blocks (also called dollies or sheaves) and with single-leader "p-line" ropes that reach the ground. Stringing blocks are a type of pulley that attaches to the insulator assembly and temporarily support a pulling rope or p-line and a wire rope or "hard line," which in turn supports the conductor before it is permanently "clipped in."

The process starts as the construction crew pulls the p-lines toward the first structure beyond the setup area. The p-lines are normally pulled down the right-of-way with a small wide-track bombardier or other small equipment. At each structure, the ropes are detached from the bombardier and attached to the single leader p-line to lift the ropes up into the dollies. Then the ropes are reattached to the bombardier and driven to the next structure for the same process. After the p-line has been strung through all the structures for all phases within the stringing interval, the pulling ropes are attached to a hard line and pulled, one at a time, back through the dollies to the beginning of the interval. A hard line set-up is located at the opposite end of the interval from the wire stringing setup area. Each hard line is then attached to the conductor wire with an attachment called a "sock," which is pulled back through the dollies to the end of the interval. Crewmembers travel along the access route in a pickup truck, follow the "sock" as it is being pulled to make sure it does not get hung up in the dollies. One at a time, the

conductor wires are then pulled to the appropriate tension and clipped into place utilizing permanent suspension hardware. Wire stringing and hard line setup areas are normally located in upland areas during spring, summer, or fall conditions.

During winter when frozen conditions provide a stable working surface, set-ups may be located in wetland areas. If set-ups in wetlands are required when surface conditions are not stable, extensive use of timber matting is required.

The most effective means to minimize impacts to water areas during construction is to span streams and rivers by placing structures above the normal high water level. In general, construction equipment is not permitted to be driven across waterways except under special circumstances, and then only after discussion with the appropriate resource agency. Where waterways must be crossed by construction equipment the Applicants would use temporary clear span bridges to minimize the impact on the waterway. For those waterways that cannot be crossed with construction equipment, workers might walk across or use boats during wire stringing operations to pull in the new conductors and shield wires or in the winter drive equipment across the ice. In areas where construction occurs close to waterways, appropriate measures would be employed to minimize soil erosion and prevent sedimentation of the waterways. The Applicants would ensure that equipment fueling and lubricating occur at a reasonable distance from waterways.

Substations

Two new 230 substations – the Mine Substation and the Steel Plant Substation – would be constructed to serve the electric load of the ESM Plant. There would also be substation modifications made at the MP 230 kV Blackberry Substation to accommodate the proposed 230 kV transmission line entrance. A new transformer would not be required at the Blackberry Substation. Construction work on the two new substations would occur on ESM property.

The substations would be built or modified in compliance with applicable requirements of the National Electrical Safety Code (NESC), Occupational Safety and Health Act (OSHA), and State and local regulations. The final design of the new and modified substations would take the local conditions of the sites into consideration, and where warranted, would include safety provisions beyond the minimum requirements established in the various applicable safety codes. Contractors would be required to adhere to all such safe working practices. The new and modified substations would be designed to allow future maintenance to be done with minimum impact on substation operation and with the necessary clearance from energized equipment to ensure safety.

Construction of the new substations would begin once the final design is complete and the property or easements are acquired. A detailed construction schedule would be developed based upon availability of crews, outage restrictions for any transmission lines that may be affected, weather conditions, spring load restrictions on roads, and any restrictions placed on certain areas for minimizing impacts from construction.

All vegetation would be cleared from the substation footprint area, from the substation driveway area, and from a buffer area of 20 feet outside the substation fence. Vegetation on the property outside of the substation footprint, driveway, and buffer would be left undisturbed, except where it must be removed to allow for safe operation of the transmission lines entering the substation.

Approximately seven acres of land would then be graded to construct the Steel Plant Substation and three acres for the Mine Substation. The concrete foundations would be poured to support the substation equipment and control house. Once the site is graded, a perimeter fence would be installed to secure the site and substation erection would commence.

The Applicants would utilize erosion control methods to minimize runoff during substation construction. Construction crews would comply with local, State, NESC, and MP standards during construction of the substations.

Modifications to the Blackberry Substation would be completed within the substation fence line so no vegetation clearing would be required. Concrete foundations would be poured to support the substation equipment. Below grade control and communication cables would then be installed and the new substation equipment would be installed.

If ground outside of the existing substation is disturbed, MP would utilize erosion control methods to minimize runoff during construction. MP construction crews or an MP contractor would comply with local, State, NESC, and MP standards during construction of the substation modifications.

4.2.3 Restoration Procedures

Limited ground disturbance would occur at the transmission line structure sites during construction. For example, the construction contractor generally establishes a main staging area for temporary storage of materials and equipment. A previously disturbed or developed area is typically used. Such an area includes sufficient space for construction trailers, to lay down material, and pre-assemble some structural components or hardware. Other staging areas located along the right-of-way are limited to a structure site for lay down and framing prior to structure installation. Stringing setup areas are also used to store conductors and the equipment necessary for stringing operations. Disturbed areas are restored to their original condition to the maximum extent practicable, or as negotiated with the landowner.

Unless otherwise agreed upon by the landowner, all storage and construction buildings, including concrete footings and slabs and all construction materials and debris, would be removed from the site once construction is complete. Post-construction reclamation activities involve restoring the areas to their original condition to the extent practicable, including removing and disposing of debris; removing all temporary facilities, including staging and laydown areas; employing appropriate erosion control measures; and reseeding areas disturbed by construction activities with vegetation similar to that which was removed, as appropriate.

Post-construction reclamation activities at the substation sites include the removing and disposing of debris, dismantling all temporary facilities (including staging areas), employing appropriate erosion control measures, and reseeding areas disturbed by construction activities with vegetation similar to that which was removed. Where appropriate, MP would incorporate methods to visually screen the final site.

Seed mixture would be certified as free of noxious or invasive weeds. In cases where soil compaction has occurred, the construction crew or a restoration contractor would use various methods to alleviate the compaction, as negotiated with landowners.

Once post-construction reclamation is completed, landowners are contacted by the right-of-way agent to determine if the clean-up measures have been finished to their satisfaction and if any other damage may have occurred. If damage has occurred to crops, fences or the property, the Applicants would compensate the landowner. In some cases, an outside contractor may be hired to restore the damaged property as near as possible to its original condition.

4.2.4 Maintenance Procedures

Transmission Line

Access to the transmission lines' rights-of-way is required to perform periodic inspections, conduct maintenance, and repair damage. Regular maintenance and inspections would be performed during the life of the transmission line to ensure its continued integrity.

Inspections would be limited to the rights-of-way and to areas where obstructions or terrain may require off-right-of-way access. If problems are found during inspection, repairs would be performed and the landowner would be compensated for any loss.

The rights-of-way would be managed to control vegetation that interferes with the operation and maintenance of the transmission line. Sections of the Project routes would be in forested areas, requiring tree trimming or removal to maintain the integrity of the transmission line. Native shrubs that would not interfere with the safe operation of the transmission line would be allowed to re-establish in the rights-of-way. The Applicants' practice provides for the inspection of major transmission lines every year to determine if clearing is required. Other transmission lines are typically reviewed on a two-year cycle. Right-of-way clearing practices include herbicide application where allowed or a combination of mechanical and hand clearing when required, to remove or control vegetation growth. Noxious weed control with herbicides would be conducted on a two-year cycle around structures and anchors, where approved for use.

Substations

Inspections would be performed regularly over the life of the substations to maintain equipment and make necessary repairs. Routine maintenance would be conducted as required to remove undesirable vegetation that may interfere with the safe and reliable operation of the substations.

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