Risk Mitigation Planning for a Successful Project

Ajay Mallik, P.E., P.Eng.
SANPEC, Inc.
Ph: 832-392-4230
ajmallik@sanpec.com

Michael Foster, P.E., P.Eng.
Dashiell Engineering, Inc.
Ph: 512-238-5314
Michael.Foster@dashiell.com

Casey Miller, P.E., P.Eng.
Dashiell Engineering, Inc.
Ph: 713-578-6203
Casey.Miller@dashiell.com
Discussions

✓ Current Trend in Large Transmission Line Project (“EPC Business Model”)
✓ State EPC Challenges
✓ Review EPC Principal Functions
✓ Case Study of an EPC Project “WFMAC”
✓ QA/QC programs/ITP
✓ Construability Assessment
✓ Disadvantages
✓ Conclusions
✓ Q&A
Current Trend

✓ Common Business Model in Power Transmission Industry for Large Projects

✓ Owners:
  ✓ Majority of Utility Customers
  ✓ Merchant Transmission Developers
  ✓ Renewable Customers

✓ Bidding Process
  ✓ Competitive bidding
  ✓ Open Book Partnership
Why Choose EPC?

✓ Delivers a complete package of resources, products, innovations, and management
✓ Provides full life cycle of a project from design to commissioning
✓ Transfer Risk from Owner to EPC contractor
  ▪ Budget/Schedule/Performance Risks
✓ Contractor is responsible for critical success factors:
  - Creating and maintaining the highest safety standards
  - Mandating and achieving an aggressive completion schedule
  - Integrating quality into the work from conceptual design through the final installation
  - Delivering a competed project fit for purpose and at the least capital cost
EPC Challenges

✓ Execute EPC Projects within budget and schedule
✓ Minimize construction delays due to lagging information, material or environmental constraints
✓ Track progress and maintain contingency plans to stay on schedule
✓ Document project progress in terms of installed structures
✓ Identification of project risk due to unforeseen changes
✓ Procurement process from global suppliers
EPC Functions

Value Engineering

Partner With Vendors

Constructability
A Case Study EPC Project

The West Fort McMurray ("WFMAC") 500 kV Transmission Line Project includes over 310 miles (500 km) of high voltage transmission line, expansion of the existing Livock substation, and construction of the new Thickwood Hills substation, all located in Northcentral Alberta. The project had a required in-service date of mid-2019.

Fort McMurray West 500 kV Transmission Project

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<tr>
<td><strong>Scope</strong></td>
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<td><strong>Term of agreements</strong></td>
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<td><strong>Energization date</strong></td>
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<td><strong>Procurement delivery option</strong></td>
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<td><strong>Winning bid price (Net present cost)</strong></td>
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<td><strong>Payment mechanism</strong></td>
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* All project costs
** The AESO long term planning estimate for this project was Cdn $1.8 billion +/- 50% and included construction costs only.
Transmission Map
Project Timelines

The Project Schedule

February 2013: The Alberta Utilities Commission (AUC) approves the Alberta Electric System Operator (AESO)

May to June 2013: Request for Expression of Interest (REOI) Stage for Fort McMurray West 500-kV Transmission Project

July 2013: Request for Qualification (RFQ) Stage for Fort McMurray West 500-kV Project Opens

October 2013: RFQ submission deadline

December 2013: Invitation to participate in Request for Proposal (RFP)

December 2013 to December 2014: RFP Stage

December 2014: Project awarded

January 2015: Project notification and consultation activities begin

February 2015: Open houses held

Once open houses are completed and affected landowners have been consulted, we will begin to assess and select route options. Consultation with landowners and interested parties will continue throughout the route selection process.

December 2015: Facilities application filed with the AUC

Once the facilities application is filed, we will begin the right-of-way acquisition process. The AUC's review process will continue.

January 2017: If approval is granted by the AUC, construction begins

June 2019: Facilities completed and operating

The Regulatory Process

- Public engagement begins with sharing information about the project and gathering input from the public
- Input from personal consultations and other sources are used to select the best option(s)
- APL submits an application to the AUC to build the proposed facilities
- The AUC reviews the application in a public process
- If approved, construction of the new facilities begins
Alberta PowerLine is a partnership between ATCO and Quanta Services to design, build, own and operate the Fort McMurray West 500-kV Transmission Project.
Valard Construction: A Canadian subsidiary of Quanta, will provide turnkey EPC (Engineering, Procurement and Construction) services for the project. Engineering will be performed by multiple Quanta Operating Units. Dashiell / Quanta Subsurface / Quanta Technology.
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<tr>
<th>Agency</th>
<th>Item</th>
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<tr>
<td>Federal</td>
<td>Navigable Waters</td>
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<tr>
<td>Transport Canada</td>
<td>Aeronautical Obstruction Clearance</td>
</tr>
<tr>
<td>Provincial</td>
<td>Highway Crossing Permits</td>
</tr>
<tr>
<td>Alberta Transportation</td>
<td>Highway Approaches</td>
</tr>
<tr>
<td>Provincial</td>
<td>Highway Adjacent Development</td>
</tr>
<tr>
<td>Alberta Environment and Sustainable Resource Development</td>
<td>Wetland Impact Permits</td>
</tr>
<tr>
<td>Alberta Environment and Sustainable Resource Development</td>
<td>Wildlife Timing and Mitigation</td>
</tr>
<tr>
<td>Alberta Culture</td>
<td>Crown Land Dispositions</td>
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<tr>
<td>Alberta Environment and Sustainable Resource Development</td>
<td>Historical Resource Act Clearance</td>
</tr>
<tr>
<td>Alberta Utilities Commission</td>
<td>Permit to Construct and License to Operate</td>
</tr>
<tr>
<td>Municipal</td>
<td>Road Crossings</td>
</tr>
<tr>
<td>County (various)</td>
<td>Road Approaches</td>
</tr>
<tr>
<td>Other</td>
<td>Land rights/acquisition</td>
</tr>
<tr>
<td>Landowners</td>
<td>Timber rights (TDA)</td>
</tr>
<tr>
<td>Other</td>
<td>Facility Encroachments</td>
</tr>
<tr>
<td>Industrial Landholders</td>
<td>Pipeline Crossings</td>
</tr>
<tr>
<td>Other</td>
<td>Distribution Power Line Crossings</td>
</tr>
<tr>
<td>Other</td>
<td>Transmission Power Line Crossings</td>
</tr>
<tr>
<td>Other</td>
<td>Road Crossing Agreements</td>
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<tr>
<td>Other</td>
<td>Road Use Agreements</td>
</tr>
<tr>
<td>Other</td>
<td>Railway Crossings</td>
</tr>
</tbody>
</table>
Design Requirements

- 500kV 2,600 MVA (3,000 amps)
- 100 Year Return Period Weather Loading
- 80 Year Life Expectancy Structure & Foundations
- 50 Year Life Expectancy Conductor and Hardware
- Surge Impedance Loading Limits
- Line Resistance Limits
- Negative Sequence Limits
Engineering Data

- Multiple Iterative Designs
- Electrical Studies
- Conductor Optimization
- Structure Optimization
- Foundation Optimization
- Final IFC Package

<table>
<thead>
<tr>
<th>LOAD CASE</th>
<th>LOADING COMBINATION</th>
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<tbody>
<tr>
<td>1</td>
<td>CSA MEDIUM LOADING 400 Pa WND, 5.5 mm ICE, -20°C; 900 kg/m³</td>
</tr>
<tr>
<td>2</td>
<td>HIGH WIND 750 Pa WND, 0 mm ICE, 40°C</td>
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<tr>
<td>3</td>
<td>WET SNOW 0 Pa WND, 50 mm SNOW, -20°C; 350 kg/m³</td>
</tr>
<tr>
<td>4</td>
<td>UNBALANCED SNOW, 0 Pa WND, 50 mm SNOW, 0°C; 350 kg/m³</td>
</tr>
<tr>
<td>5</td>
<td>WET SNOW &amp; WIND, 230 Pa WND, 50 mm SNOW, -5°C; 350 kg/m³</td>
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<tr>
<td>6</td>
<td>BROKEN WIRE 0 Pa WND, 0 mm ICE, -30°C</td>
</tr>
<tr>
<td>7</td>
<td>CONSTRUCTION &amp; MAINTENANCE, 45 Pa WND, 0 mm ICE, -30°C</td>
</tr>
<tr>
<td>8</td>
<td>CONSTRUCTION TIE-DOWN, 45 Pa WND, 0 mm ICE, -30°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE DESIGN DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
</tr>
<tr>
<td>NAME</td>
</tr>
<tr>
<td>STRANDING</td>
</tr>
<tr>
<td>UNIT WEIGHT (N/m)</td>
</tr>
<tr>
<td>DIAMETER (mm)</td>
</tr>
<tr>
<td>STRENGTH (kn)</td>
</tr>
<tr>
<td>CONFIGURATION</td>
</tr>
<tr>
<td>RATINGS (kA2*S)</td>
</tr>
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</table>
## Structures Types

<table>
<thead>
<tr>
<th>STRUCTURE TYPE</th>
<th>DEFLECTION RANGE</th>
<th>RULING SPAN (m)</th>
<th>WIND SPAN (m)</th>
<th>WEIGHT SPAN (m)</th>
<th>Maximum Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATTICE GUYED-V TANGENT</td>
<td>0°-1°</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>46</td>
</tr>
<tr>
<td>LATTICE SELF-SUPPORT TANGENT</td>
<td>0°-1°</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>46</td>
</tr>
<tr>
<td>LATTICE GUYED-V RUNNING ANGLE</td>
<td>1°-20°</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>46</td>
</tr>
<tr>
<td>LATTICE ANTI-CASCADE DEADEND</td>
<td>0°-25°</td>
<td>400</td>
<td>550</td>
<td>800</td>
<td>67</td>
</tr>
<tr>
<td>LATTICE DEADEND</td>
<td>0°-45°</td>
<td>400</td>
<td>550</td>
<td>800</td>
<td>46</td>
</tr>
<tr>
<td>LATTICE DEADEND</td>
<td>45°-90°</td>
<td>400</td>
<td>550</td>
<td>800</td>
<td>46</td>
</tr>
<tr>
<td>MONOPOLE H-FRAME TANGENT</td>
<td>0°-1°</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>52</td>
</tr>
<tr>
<td>MONOPOLE DOUBLE CIRCUIT TANGENT</td>
<td>0°-1°</td>
<td>224</td>
<td>300</td>
<td>500</td>
<td>62</td>
</tr>
</tbody>
</table>

Total # of Structures: 1348  
Total Approx. Tonnage: 43 M Lbs.
Structure Testing
Structure Testing

- Tallest Tower Tested
- Critical Steel Type
- Strain Gauges
- Load Cell Calibration
- Post Test Material Sampling
Foundations Design

- Foundation design and installation typically poses the greatest cost risk of a project.
- Minimal geotechnical information can cause variations in bids due to different assumptions on soil profiles.
- Quanta Subsurface utilized geologic and soil mapping data to develop preliminary soil profiles for the purpose of bidding.
- Preliminary foundation designs were developed for each soil profile.
- Each structure location was assigned a soil profile and the appropriate foundation type was selected.
Foundations Design

 ✓ Multiple Foundation Types were designed including:
   ✓ Drilled Shafts
   ✓ Driven Pile
   ✓ Grillage
   ✓ Helical Pile
   ✓ Micropile
Global Procurement

Material Suppliers/Vendors:
USA/Canada/Turkey/Italy/China/India
Material Design & Testing

- Development of detailed manufacturing specifications
  - Codes & Standards
  - Submittals
  - Material
  - Design Requirements
  - Testing
    - Type Testing
    - Sample Testing (Random Sample per Lot)
    - Routing Testing (Performed on all pieces)

- Factory Audits
  - Verify QA/QC Program
  - Verify Manufacturing Quality
  - Verify Raw Material Testing
QA/QC- Goal

- Perform robust Quality Inspection of Transmission Structures at Suppliers Plant before shipping
- Ensure all parties (Customer and Supplier) clearly understand the “Contract requirements” before start of fabrication
- Ensure that the customer receives the quality product in accordance of with Contract, applicable Standard and specification requirements
- Independent determination of product conformity/nonconformity as per specifications
- Independent observation of manufacturing process and all welding activities for conformance to AWS D1.1 Structural Welding Code
QA/QC- Objectives

✓ Verify the supplier's intentions to meet the order requirements "before" the start of fabrication
✓ Verify that supplier's quality control, inspection and test capabilities match the need for the project.
✓ Resolve discrepancies and deviations from the specs during fabrication and before shipment
✓ Overview constructability process and mitigate project risk and challenges
✓ Increase flexibility for changes in workload
✓ Assure improvements in supplier, program, and business performance
✓ Overall improvement in quality of supplier’s finished products
INSPECTION FLOW CHART

Main Steps:

1. CUSTOMER REQUIREMENT
2. IMPLEMENT PROGRAM
3. SCREEN & QUALIFY
4. TRAINING & ORIENTATION
5. SCHEDULE INSPECTION
6. PERFORM INSPECTION
7. REPORT RESULTS
INSPECTION PROCESS

✓ Inspection process mirrors the process of the life cycle in designing and procuring the structures and ensures that all issues are looked at and that there are “no surprises” in the end.

Three Basic steps for Inspection Process:
○ Develop and create a source inspection plan (ITP) that includes procedures, checklists, forms, and training programs.
○ Screen and qualify Project Inspectors to perform the detailed inspections. The selection of the Inspectors should be based on technical skills and proximity to suppliers.
○ Effective program management and technical support utilizing online tools for real-time access to schedules, status, results, and reports.
INSPECTION PLAN DEVELOPMENT

✓ Develop Inspection Plan for the specific products being manufactured
✓ Inspection document includes as follows (minimum):
  o ITPs
  o Structural Specifications
  o Approved Shop Drawings with tolerances
  o Grade/Type of Steel
  o Unique testing requirements
  o Fabrication & Delivery schedule
  o Specific information per Design requirement
✓ Establish the pass/fail criteria
✓ Frequency of inspections
✓ Report results
INSPECTORS

- Establish selection criteria for experienced & knowledgeable inspectors
  - Min. Educational & Work Experience background
  - Knowledge of all aspect of manufacturing process
  - Thorough understanding applicable US codes and standards such as AWS D1.1, ASTM, ASCE, IEEE etc.
  - Bilingual if fabrication performed outside USA

- In-House or 3rd party contractors on part-time or full-time basis

- Job orientation program prior to start the inspection
  - Structural Specifications
  - Copies of Inspection Documents
  - Checklists & Forms
  - Acceptance/Rejection Criteria
  - Understanding of proper reporting processes

- Ability to resolve issues in a timely manner

- Direct access to Client's Engineer/Project Manager
PROGRAM MANAGEMENT

✓ Effective & Efficient Source Inspection Program Management
✓ Reports all information in a timely manner
✓ Assign a dedicated Project Manager for all inspection process
  o Have direct control over all inspectors at supplier's facilities
  o Help in selection of qualified inspectors
  o Directly report to Client’s Representatives
  o Send daily/weekly/monthly reports
  o Facilitate meeting (daily or weekly) with Client’s
  o Discuss any ongoing issues
  o Look Ahead for upcoming inspections process
✓ Utilize Online tools for real-time access schedules, status, results and reports.
  o Develop a robust online tools for easy access 24/7
  o Helps in tracking the submission and transmission documents
  o Easy and effective ways of communication and notification to all parties
  o Available reports and information at one place
SAMPLE INSPECTION REPORT RESULTS

✓ Project Name: Name of the Client’s project
✓ Project Purchase Order No.: Purchase order between the Supplier and Client
✓ Client’s Name: Name of the Client whom is buying the material
✓ Manufacturer & Location: Name of the Supplier and address
✓ Manufacturer Contact: Supplier’s Project Manager’s name and phone number
✓ Inspection Date & Time: Date and time of the inspection conducted
✓ Description of items Inspected/Expedited: Inspection category can be raw materials, fabrication, galvanizing, bundling and shipping
✓ Summary of Inspections performed: Point out if anything does not comply with the Client’s Specification during raw materials, fabrication, galvanizing, bundling and shipping inspection
SAMPLE INSPECTION REPORT RESULTS

✓ **Concerns & remarks**: Express the concerns and remarks about inspecting raw materials, fabrication, galvanizing, bundling and shipping

✓ **Attachments**: Take lots of photo and attach them with the report. Also, attach any other documents from the supplier regarding QC and process.

✓ **Inspected By**: Name of the inspector

✓ **Date**: Date of the inspection
Inspection Test Plans

- Develop Inspection Plan for each manufacturer
- Provide specification requirements in a format for manufacturing
- Provide method of test, acceptance criteria, frequency, etc.
- Specify hold points.
Material Management
Construction
Construction
Construction
Disadvantages

✓ Owners cannot change scope or standards during project without some cost impact. This can be mitigated by having a well-defined project scope and project requirements.

✓ The owner transfers the project execution risk to the EPC companies. So it is important to choose the right EPC company. Choosing a company that is financially stable and has a proven track record of executing projects is key to ensure project success.

✓ Unknow or unclear scope can result in higher costs if the EPC company is required to make assumptions to cover unknown risk.
Conclusions

✔ Case Study project of WFMAC was completed 91 days ahead of schedule and under budget.

✔ EPC business model delivers complete package of resources, products, innovations, and management

✔ Because of risk transfer, it is important to choose the right EPC companies

✔ EPC concept is helpful where the total prices and duration of the contract are fixed

✔ Key to Success:
  ❖ Value Engineering – Optimization Process
  ❖ Partners with Reliable Vendors- Early Participation
  ❖ Focus on Constructability Approach- Safety Guidelines
WFMAC Completion Video
https://vimeo.com/327101148
Questions?

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