

From: pathussey@nalcorenergy.com
To: clarenc Hewitt@nalcorenergy.com
Subject: Fw: Presentation - Section 9
Date: Tuesday, March 29, 2011 8:43:08 AM
Attachments: [.png](#)
[SLI Kick-off Meeting - DG2 Basis - Section 9 - Final.pptx](#)

Jason has combined ours with his overall section. Ours starts on page 19



Pat Hussey
Supply Chain Manager
Nalcor Energy - Lower
Churchill Project
t. 709 737-1493 f. 709 737-
1985
e.
PatHussey@nalcorenergy.com
W. nalcorenergy.com
1.888.576.5454

----- Forwarded by Pat Hussey/NLHydro on 03/29/2011 08:42 AM -----

From: Jason Kean/NLHydro
To: Bob Barnes/NLHydro@NLHydro, Pat Hussey/NLHydro@NLHydro, Dave Pardy/NLHydro@NLHydro, Tony Scott/NLHydro@NLHydro
Cc: Ron Power/NLHydro@NLHydro
Date: 03/29/2011 08:28 AM
Subject: Presentation - Section 9

Guys,

Attached is the combined slide deck for DG 2 basis - I have made edits to everyone's material so please review. It needs to flow as a total package.

Tks,

JK



SLI Kick-off Meeting - DG2 Basis - Section 9 - Final.pptx

Jason R. Kean, P. Eng., MBA,
PMP
Project Services Manager



(Consultant)

Lower Churchill Project

Nalcor Energy - Lower

Churchill Project

t. 709 737-1321 f. 709 737-
1985

e.

JasonKean@nalcenergy.com

w. nalcenergy.com

1.888.576.5454

You owe it to yourself, and your family, to make it home safely every day. What have you done today so that nobody gets hurt?

Decision Gate 2 Basis

Section 9

Boundless Energy



Contents

- Overview
- Basis of Design
- Master Contract Package Listing
- Project Schedule
- Capital Cost Estimate

Decision Gate 2 Basis

- Project Baseline (scope, time, cost, execution approach) defined at Decision Gate 2
- Project Baseline captured in several key Controlled Project Documents, including:
 - Basis of Design
 - Capital Cost Estimate
 - Project Control Schedule
 - Contracting Strategy & Master Contract Package List
- These documents form the basis against which Project change will be managed.

Scope Tracking & Management

Management of Change

Control Documents

- Basis of Design (Rev B1)
- Gate 2 PEP
- PM & Contracting Strategy
- Gate 2 Estimate
- Gate 2 PCS
- Master Contract Package List
- Gate 2 Org. Design

Control Documents

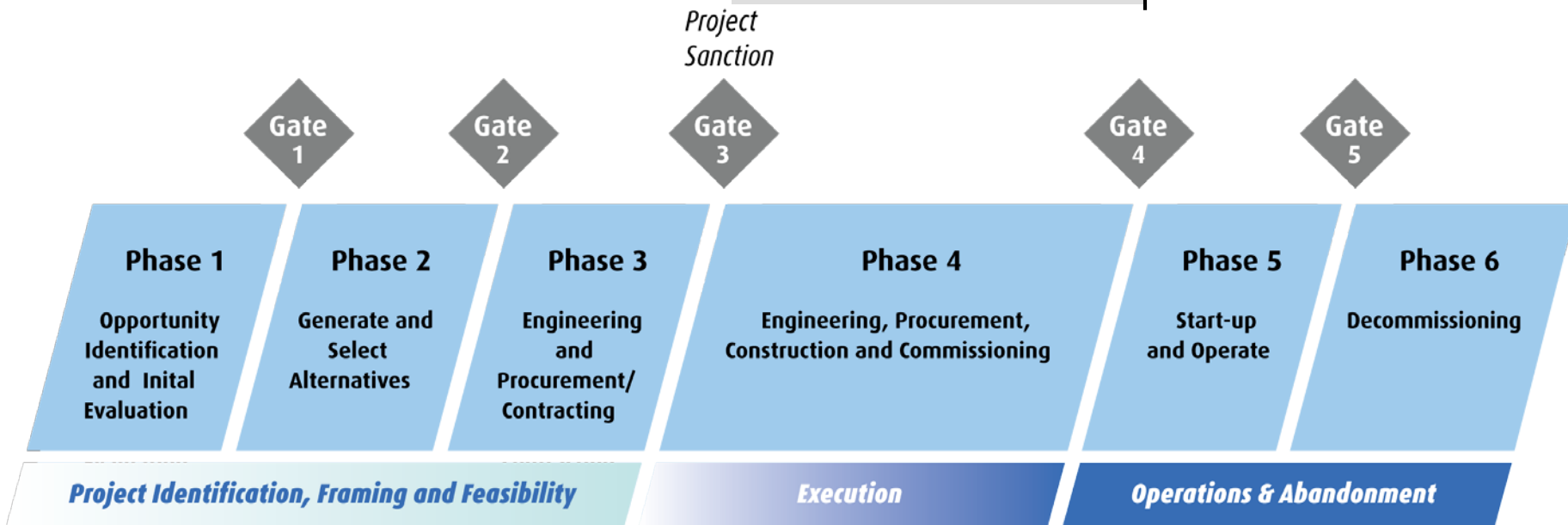
- Basis of Design (Rev B1)
- Gate 3 Project Execution Plan
- Gate 3 Estimate and Basis of Estimate
- Gate 3 Project Control Schedule (PCS)
- Design Philosophies
- Technical Specifications and Standards
- Design Criteria
- Contract Package Listing
- EPCM Execution and Select Mgmt Plans
- Construction Execution Plan
- Regulatory Compliance Plan
- Environmental Protection Plan
- Single Line Diagram
- Plot Plants (TL routing & Facility Layout)

Document Origin

NE-LCP PT


SNC-Lavalin Inc.

Establishing Controlled Project Documents



Basis of Design (BOD)

Nalcor Energy – Lower Churchill Project



nalcor
energy
LOWER CHURCHILL PROJECT

Lower Churchill Project – Basis of Design

LCP-PT-ED-0000-EN-RP-0001-01

Comments: Supersedes Document #: MSD-PM-006 Issued for Decision Gate 2	Total # of Pages (including Cover): 28 28
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B1	(1) (1)	Issued For Use <i>B. Barnes</i>	<i>B. Barnes</i>	<i>J. Mann</i>	<i>[Signature]</i>	<i>P. Harrington</i>
Status/ Revision	Date	Reason For Issue	Prepared By	Checked By	Checked By	Project Engineer Approval

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BOD Overview

- Tab 9 of your binders
- Provides an overarching Project definition at Decision Gate 2
- Revision B1 issued 14-Feb-2011
- Issued to SLI

BOD Table of Contents

- Purpose
- Scope
- Definitions
- Abbreviations and Acronyms
- Reference Documents
- Descriptions
- Drawings

BOD Scope

- LCP Phase 1
 - Muskrat Falls Hydroelectric Facility
 - Labrador – Island Transmission Link
 - Maritime Link

- LCP Phase 2
 - Gull Island Hydroelectric Facility – covered in BOD however not part of EPCM Services Agreement

BOD Reference Documents

- Reference list includes:
 - Gull Island – 29
 - Muskrat Falls – 26
 - HVac Transmission – 8
 - HVdc Systems – 26
 - Other – 18
- Details covered under Agenda Section 9.
- Not all are applicable to EPCM Services Agreement

Overarching Principles of BOD

- Proven technology
- Remotely operated plants
- Proactive environmental mitigation & rehabilitation
- Good Utility Practice
- Fail Safe Design
- Respects Nalcor H&S policies and programs
- Respects Nalcor environmental policies and guiding principles
- Respects Nalcor Asset Management policies and guiding principles

Muskrat Falls

- LSL = 38.5 m; FSL = 39.0 m; MFL = 44.0 m
- 4 – 206 MW units, Kaplan turbines
- 4 units, 4 intakes, 4 water passages (close coupled intake/powerhouse), 4 power transformers
- Surface powerhouse, all facilities under one roof
- Main Dam to be RCC
- Spillway – combination of gates and overflow, designed for PMF
- River diversion – through partially completed spillway, CDF = 1:20/year

Muskrat Falls (cont'd)

- Reservoir Clearing – 3 m below LSL to 3 m above FSL
- Accommodation Complex – 1500 persons capacity
- No Permanent Accommodations
- Main access along new road along south side of river

HVac Transmission Line

- Interconnection of Muskrat Falls to Churchill Falls
 - 2 – 345 kV, single circuit transmission lines
 - 900 MW capacity for each line
 - Galvanized lattice steel towers
 - 1:50 year reliability level return period of loads
- Gull Island to Churchill Falls – on hold
- Granite Canal to Bottom Brook – Maritime Link

Labrador – Island Transmission Link

- 900 MW HVdc bi-pole operating at ± 320 kV
- LCC converter stations at Muskrat Falls and Soldiers Pond
- Mono-polar operation via shoreline pond electrodes
- HVdc overhead Transmission Line MF to SP
 - 450 MW per pole, single conductor
 - Galvanized lattice steel towers
 - 1:50 year reliability level return period of loads

Labrador – Island Transmission Link (cont'd)

- HVdc SOBI sub-sea cables (by Nalcor)
 - 3 cables – including 1 spare
 - 450 MW per cable
 - Cables protected along entire route
- Transition compounds each side of SOBI (by SLI)
- System upgrades (by Nalcor)
 - Conversion of 2 thermal units to synch.condensers
 - Addition of high inertia sync condensers at SP
 - Additional upgrades to NE-NLH system

Maritime Link


- 500 MW HVdc bi-pole operating at ± 200 kV
- VSC converter stations at Bottom Brook and Cape Breton
- Mono-polar operation via shoreline pond electrodes
- HVdc overhead Transmission Line BB to Cape Ray
 - 250 MW per pole, single conductor
 - Galvanized lattice steel towers
 - 1:50 year reliability level return period of loads

Maritime Link (cont'd)

- HVdc Cabot Strait sub-sea cables
 - 2 cables – no spare
 - 250 MW per cable
 - Cables protected along entire route
- Transition compounds on each side of SOBI
- HVac Transmission Line
 - 1 – 230 kV single circuit transmission line
 - Capacity TBD
 - TL corridor TBD

Contracting Strategy / Package Listing

Nalcor Energy – Lower Churchill Project






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LOWER CHURCHILL PROJECT

Muskrat Falls & Island Link Master Contract Package List

LCP-PT-ED-0000-SC-LS-0001-01

Comments: Updated for Gate 2 purposes. Includes both Muskrat Falls and Island Link Projects. For information related to Gull Island see MSD-MM-018	Total Page Count (including cover): <p style="text-align: center; color: red;">14</p>
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Approvals and Revision History						
Status / Revisions	Date	Reason For Issue	Prepared By	Checked By	Project Manager Approval	Project Director Approval
01	03-Mar-11	Issued for Use	 P. Hughey	 J. Kean	 T. Scott	 P. Marlington

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Contract Package List

- Prepared by Nalcor with input from SNC-Lavalin
- Represents a logical breakdown of Project into discrete work packages based upon known interfaces
- Ongoing market intelligence received over the past 3+ years
 - Considers market capacity limitations and EPCM execution strategy
- Consistent with DG2 project schedule and capital cost estimate
- Basis for informing business community
- **Needs to be reviewed by SLI (engineering, procurement, and construction) and validated / updated / modified / finalized**

Contract Package List

- For each package provides:
 - Name and boundaries
 - Whether it must be bid to an Innu Nation businesses first
 - Notional compensation scheme
 - Estimated manufacturing durations
 - Key engineering deliverables required to support tender
 - Estimated procurement process durations
 - Potential cash forecasting requirements

Contract Package List - Headings

- Package number
- Contract name
- Sub Project
- IBA listed contract
- Description & Scope
- Summary of key quantities
- Contract form / type
- Estimated manufacturing duration
- Mobilization time / transportation time
- Contract process duration
- Engineering deliverables
- Payment terms

Nalcor Energy - Lower Churchill Project Master Contract Package List											
Package Reference No.	Contract Name	Sub-Project	IBA Listed Contract (Yes / No)	Description & Scope	Summary of Key Quantities	Notional Contract Form	Estimated Manufacturing Duration (months)	Mobilization / Delivery Duration (mobilize personnel and / transportation)	Contract process duration (Issue EOI to award) (working days)	Engineering Deliverable Types	Project Payment Terms
A-001	Accommodations Complex Buildings	Muskrat Falls	Yes	Supply and installation of construction accommodations complex including: - Dormitories, 1,500 person capacity - Recreation Centre & Commissary (1,325 m2) - Bar / Convince / Restaurant (700 m2) - Gymnasium / Fitness Centre (1,410 m2) - Outdoor Recreation - Camp Admin. Building & Reception Centre (170 m2) - Cafeteria and Kitchens (3,080 m2) - Laundry (170 m2)		Combination - Lump Sum & Unit Rates	12 mos.	2 months	95	Contractor to Supply; Architectural layouts General Arrangement drawings Site Layout dwgs. Interface Drawings Site Location Plans and General Specifications (to be provided with all packages) Commissioning / O & M Documentation Nalcor to provide; Design Brief Functional Specification	10% Down Payment for Engineering, 10% for Long Lead Items when Orders Committed to Subcontractors (defined), 40% progress payments through manufacture, 30% on Shipment including transportation costs if these costs are to contractor, 10% upon erection at site commissioned ready for occupancy.

Contract Package List - Examples

- Accommodations Complex
- Site Access Road
- Bulk Excavation Works
- Intake and Powerhouse Construction
- RCC Dams – North & South
- Converter Stations
- Transmission Line Construction
- Turbines & Generators
- Powerhouse Building
- Reservoir Clearing

Contract Package List – Next Steps

- Additional market intelligence required to validate DG 2 basis
- Nalcor to review and agree
- Overall risk brokering strategy to be developed
- Basis of contract strategy & overall contracting plan
- Detailed contract schedule to be prepared and feed into Project Control Schedule
- Identifies IBA contracts that must be bid first to Innu Nation Businesses
- Publish on SLI and Nalcor website

Project Schedule

Nalcor Energy – Lower Churchill Project



Project Control Schedule
LCP-PT-ED-0000-EP-SH-0002-01

Comments: Prepared for Gate 2. Note: Supersedes GEN-PJ-001 & GEN-PJ-004	Total Page Count (including cover): <p style="text-align: center;">158</p>
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Approvals and Revision History						
Status / Revision	Date	Reason For Issue	Prepared By	Checked By	Checked By	Project Manager Endorsement
B1	09-Oct-10	Issued for Use	T. Scott	C. Freahe	D. Pardy	J. Kean P. Harrington
A1	03-Sept-10	Issued for Review / Comment	T. Scott			

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Basis of Schedule

- Founded upon extensive studies and planning work done for both Gull Island, Muskrat Falls, and Labrador – Island Tx Link since 2007.
- Structured around Gateway Phases, with DG 3 requirements achieved for DG 3 approval by end 2011.
- Construction-driven schedule with Engineering and Procurement scheduled to support.
 - Desire is for T/G sets to be critical path and have civil construction support installation program.

Basis of Schedule (cont'd)

- Schedule is closely aligned with DG 2 estimate (i.e. major quantities and production rates) and Contracting Strategy.
- Target Milestone Dates established using knowledge of construction durations and key activity sequence for Muskrat Falls.

Basis of Schedule

Key Planning Assumptions

- For DG2, EPCM Consultant can rapidly mobilize for contract award and prepare critical design scope required for early tendering activities.
- DG 3 achieved by end of 2011.
- Release for Environmental Assessment and subsequent approval of construction permits is a pre-requisite for start of construction.
 - MF site infrastructure (access, accommodations, construction power, communications, etc.) to start immediately

Basis of Schedule (cont'd)

Key Planning Assumptions

- Generation Project EA release to allow establishment of permanent site access prior to July 2012 start of mass excavation.
- No major schedule implications due to 2010 field investigations or MF Layout Study (MF1340).
 - Assumption must be validated given large change in key quantities.
- Labrador – Island Link EA release achieved within 12 months of Environmental Impact Statement submittal.

Basis of Schedule (cont'd)

Key Planning Assumptions

- DG 3 approval is a pre-requisite for issue of Purchase Orders for major components (turbines & generators, subsea cable, transmission hardware, etc.).
- Winter worked assumed, with double shift of 6 day @ 10hr assumed for construction.
- Reservoir clearing underway 10 months each year.
- EA Release conditions do not constraint construction schedule (e.g. migratory birds).

Basis of Schedule (cont'd)

Key Planning Assumptions

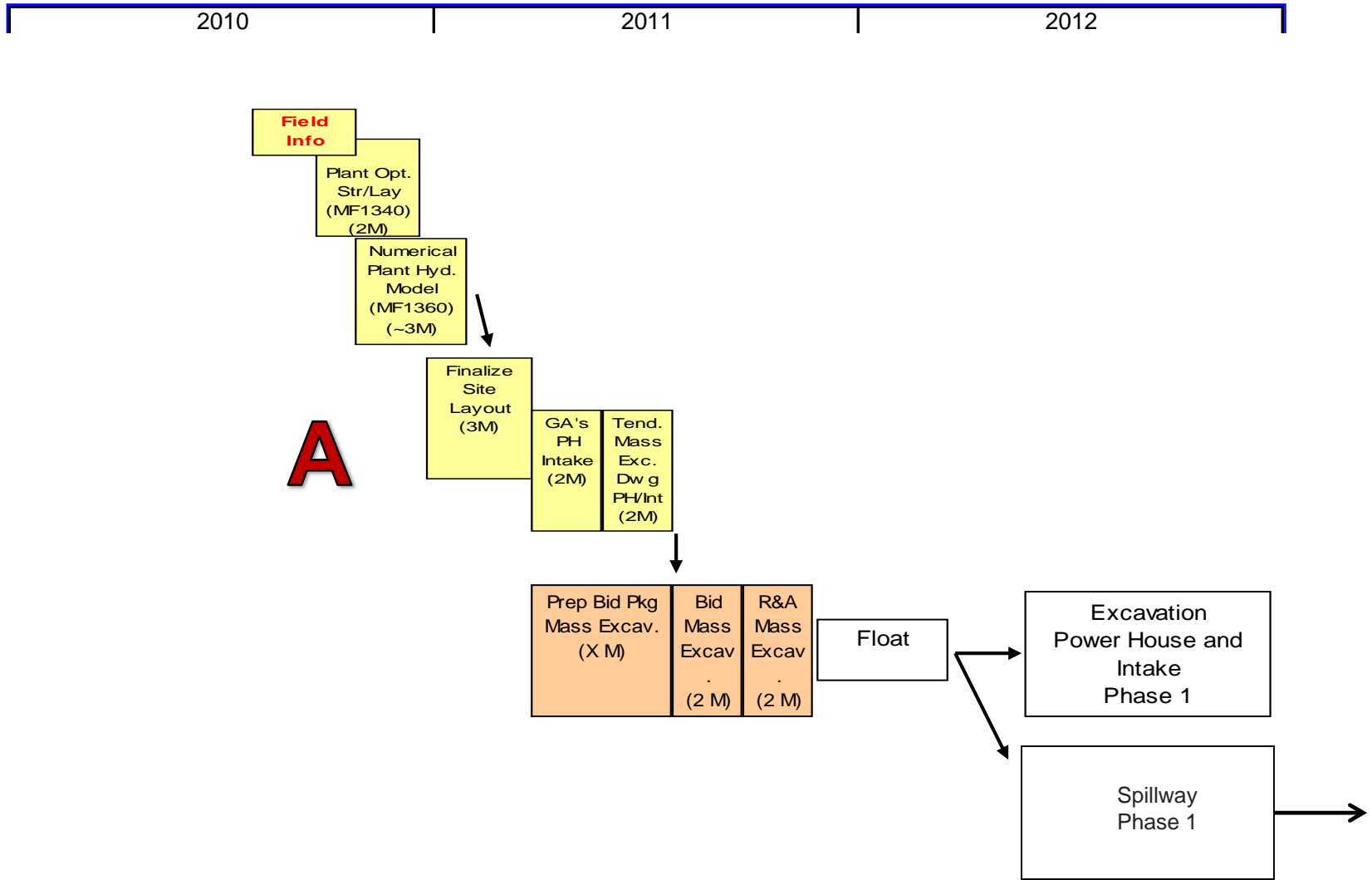
- Commissioning and First Power can be via 345 kV line to Churchill Falls.
- Labrador – Island Transmission Link must be in place for Units 3 & 4 to be commissioned.
- Muskrat Falls construction will be the dominant critical path. Labrador – Island Tx Link can be completed within the MF construction timelines.
- No labor capacity or supply chain constraints.

Schedule Driving Logic

Indicative driving logic for the Project Schedule, as discussed on the following slides, includes the following:

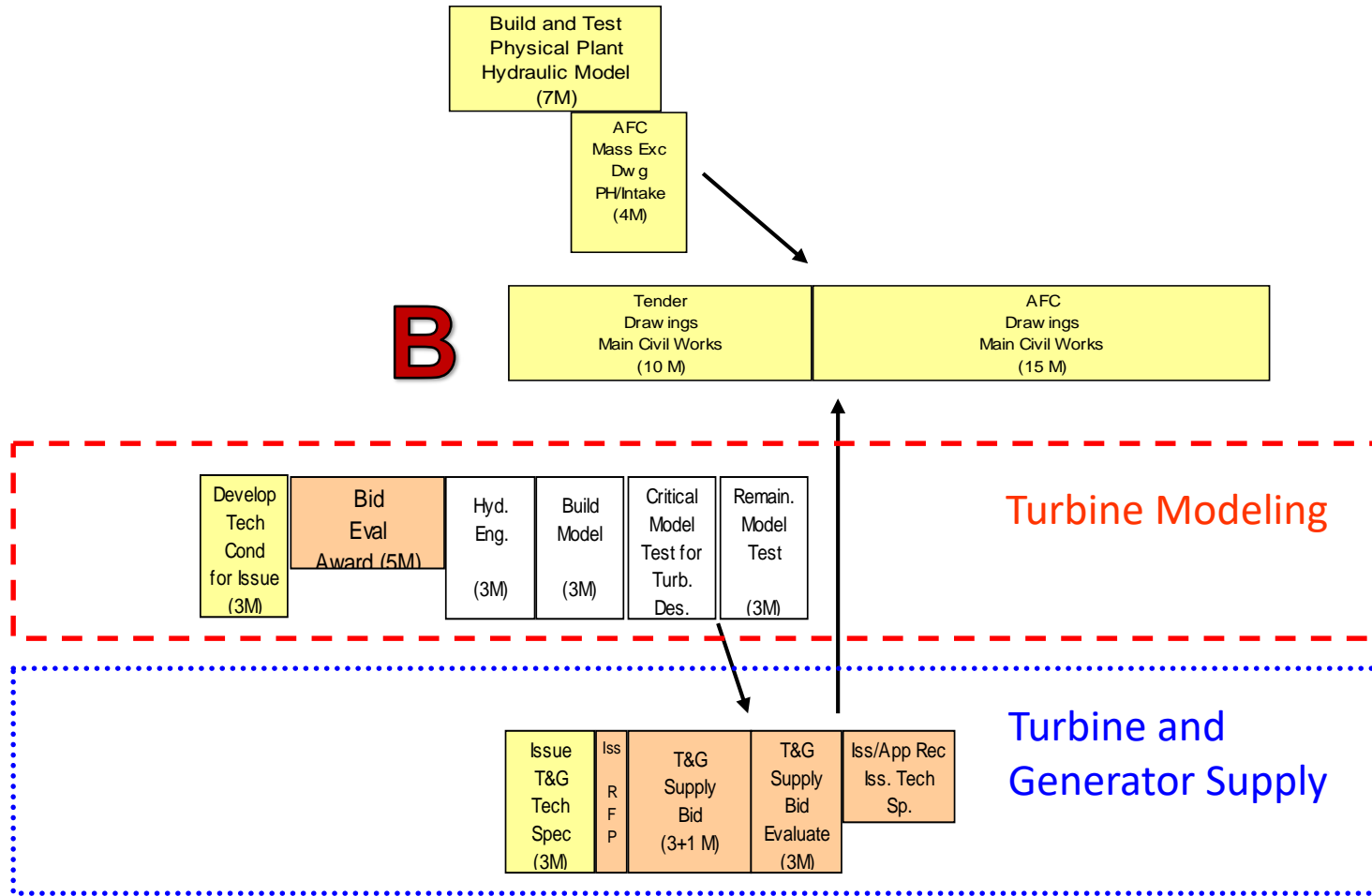
- Mass Excavation Works
- Turbine Modeling & Turbine/Generator Supply Contract
- First Turbine Component delivery affecting Civil Construction (Pier Nose)
- Spillway Gates
- Second Turbine Component Delivery affecting Civil Construction (Draft Tube & Stay Ring)
- Turbine & Generator Unit 1 Assembly & commissioning
- Dams & Reservoir
- Converter Stations
- Overhead Transmission

Mass Excavation Works



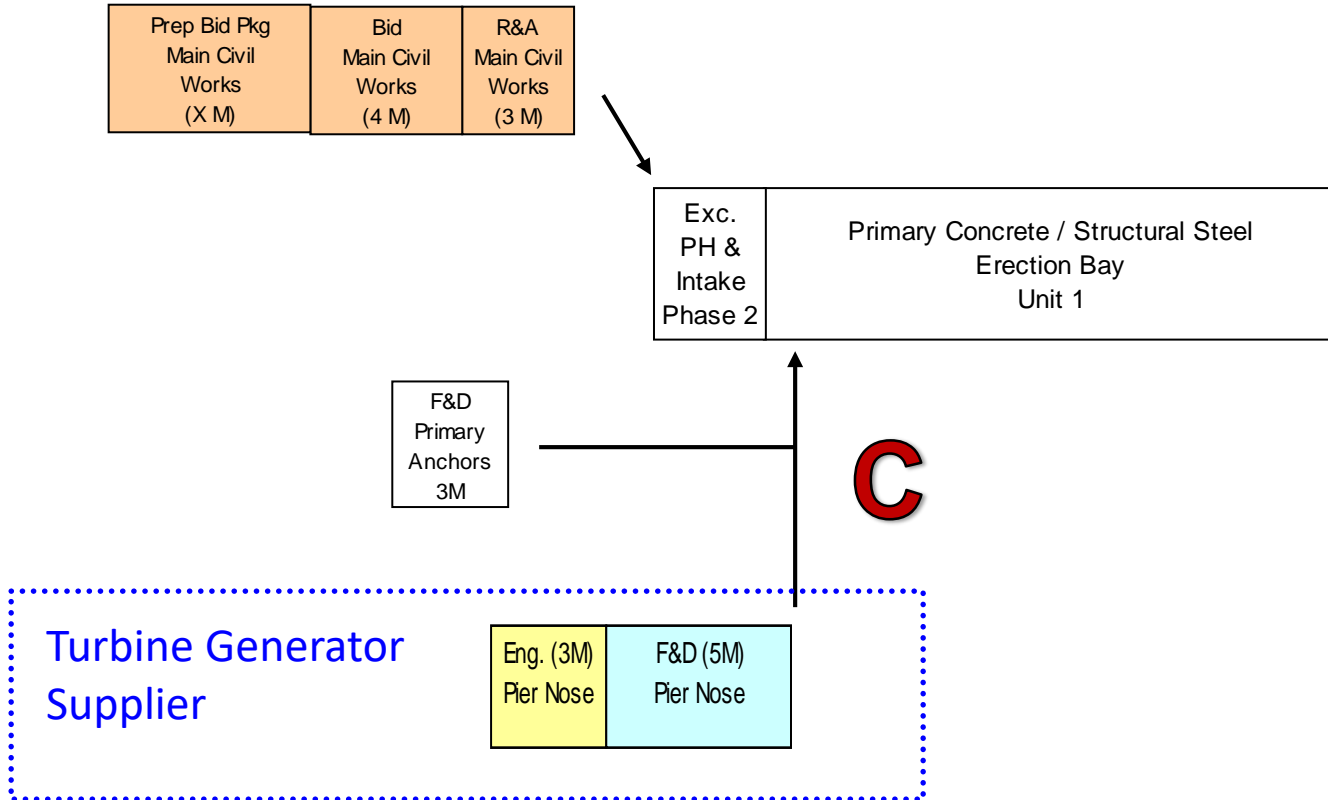
T/G Modeling & Supply & Civil Interface

2010	2011	2012	2013
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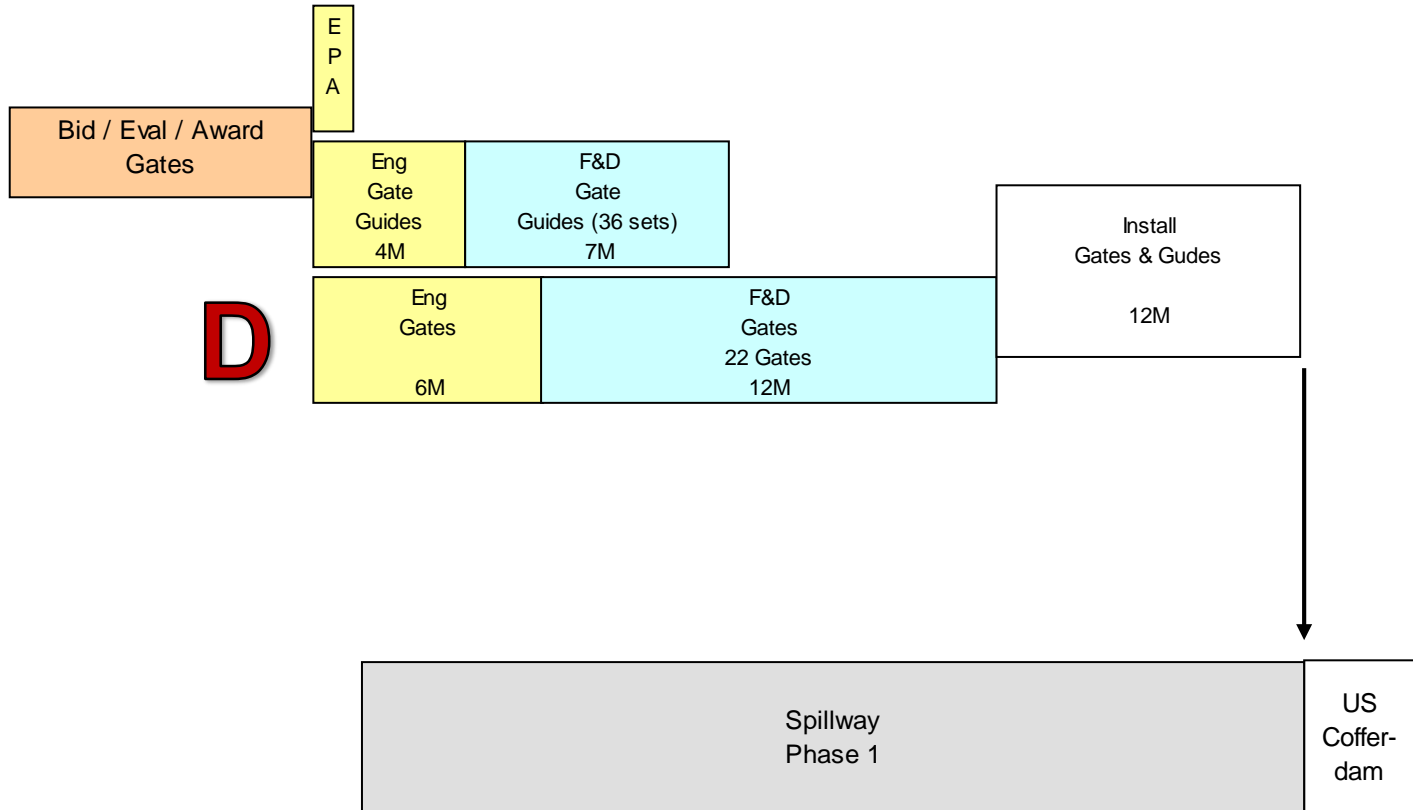
1st Delivery for T/G – Pier Nose

2011	2012	2013	2014
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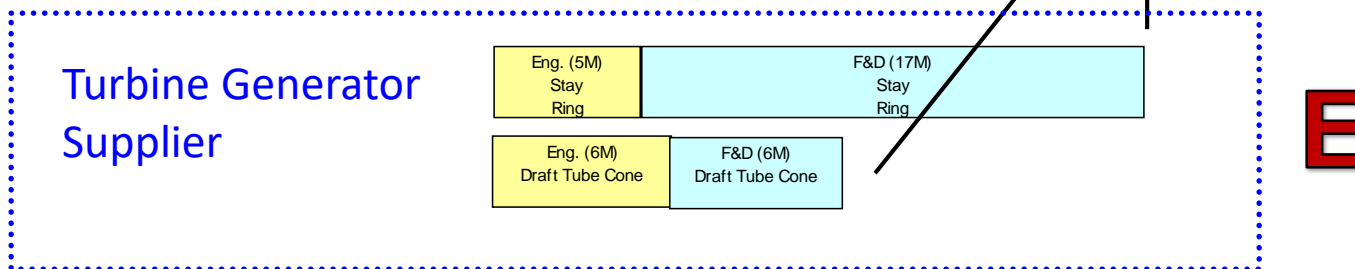
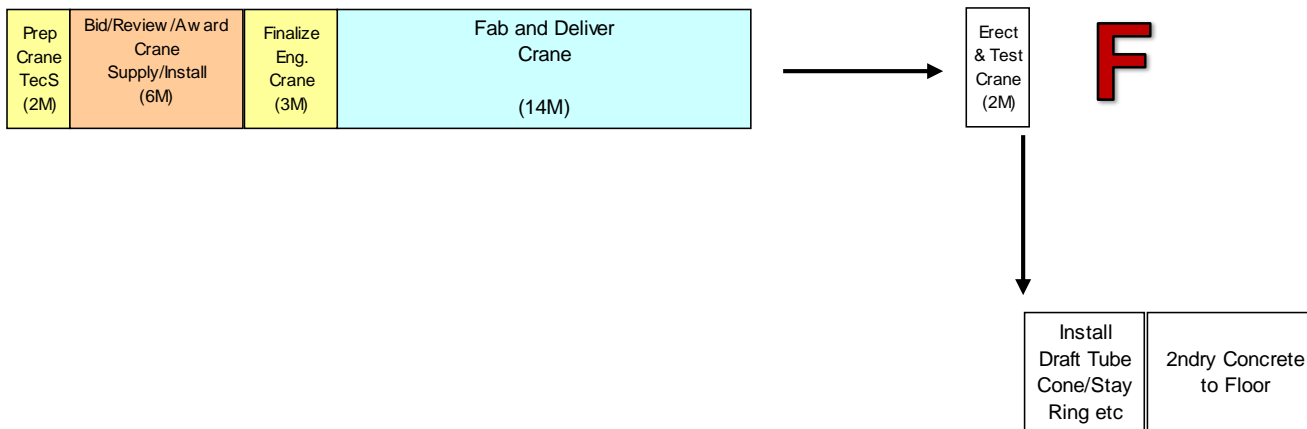
Spillway Gates for Diversion

2011	2012	2013	2014
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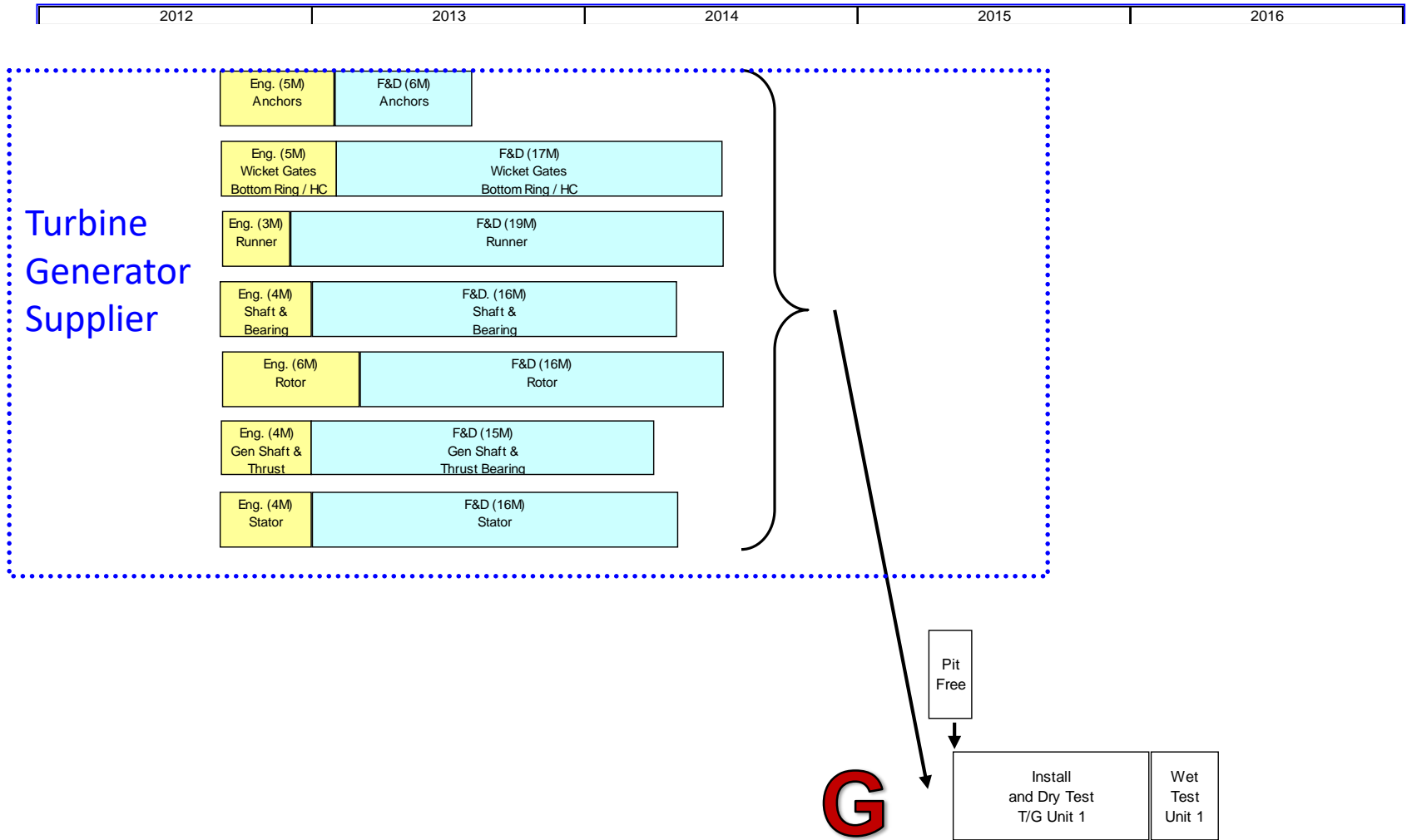


2nd T/G Components for Primary Concrete

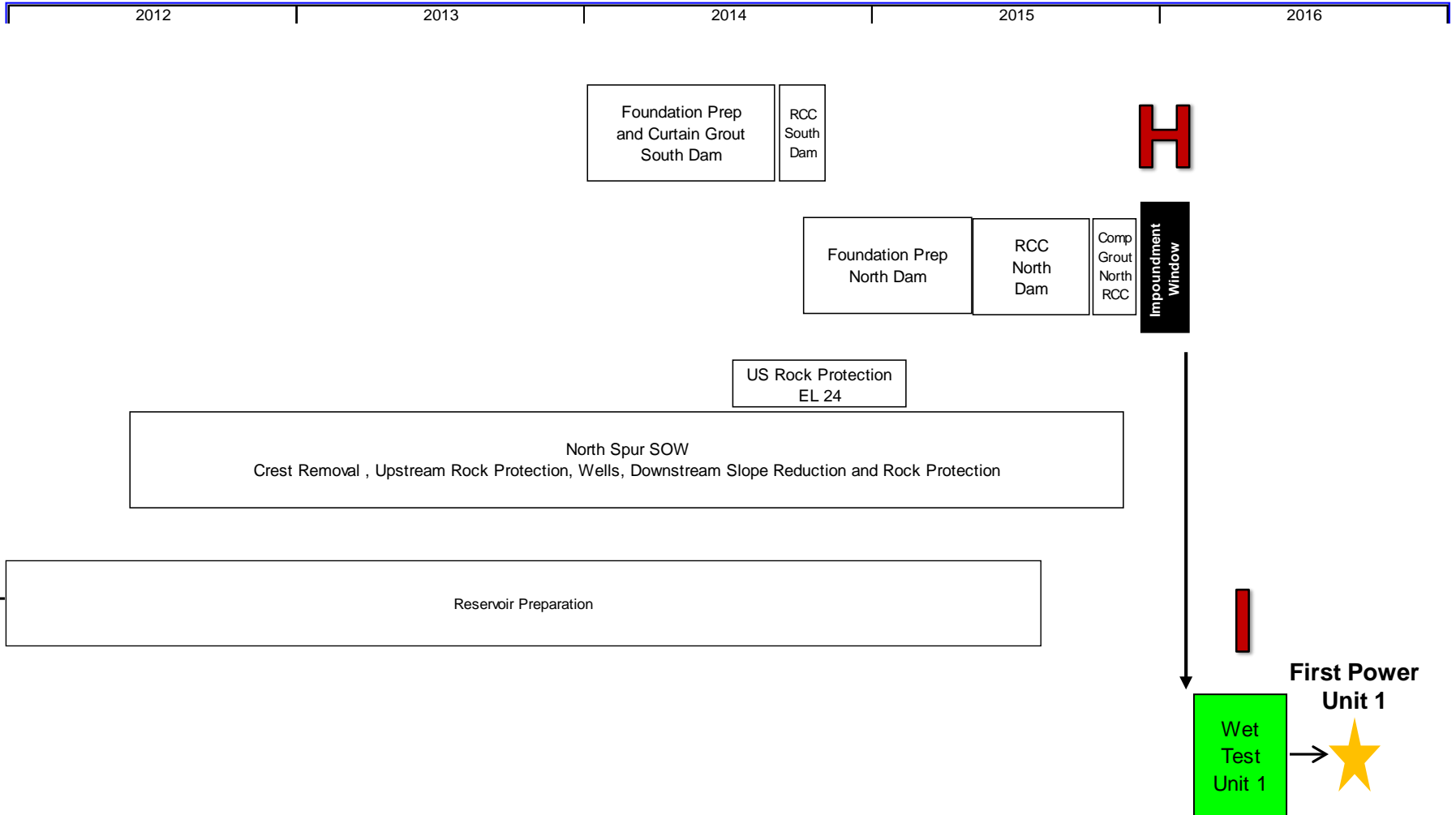
2011	2012	2013	2014	2015
------	------	------	------	------



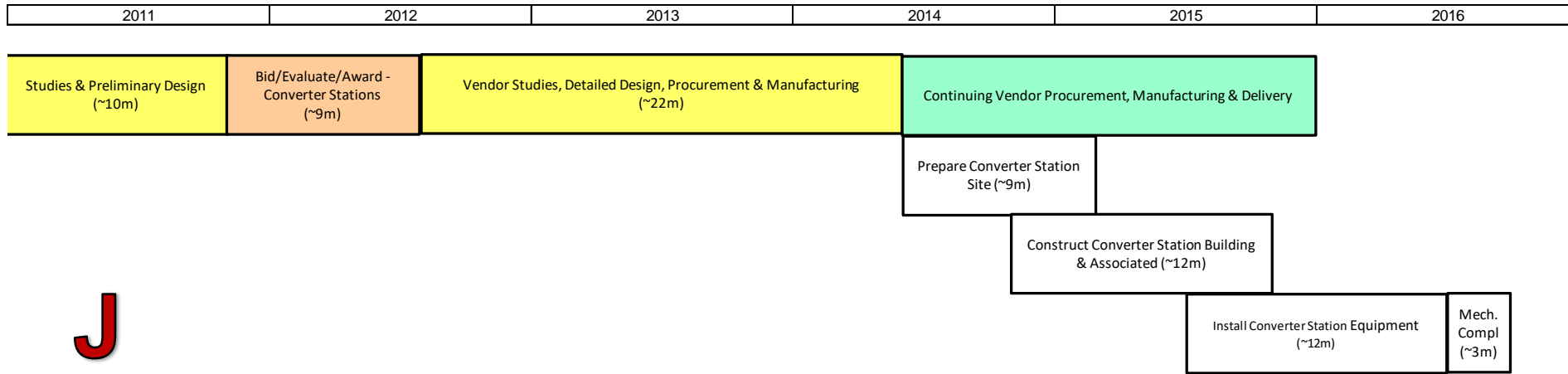
Deliver & Assemble T/G Unit 1



Dams & Reservoir

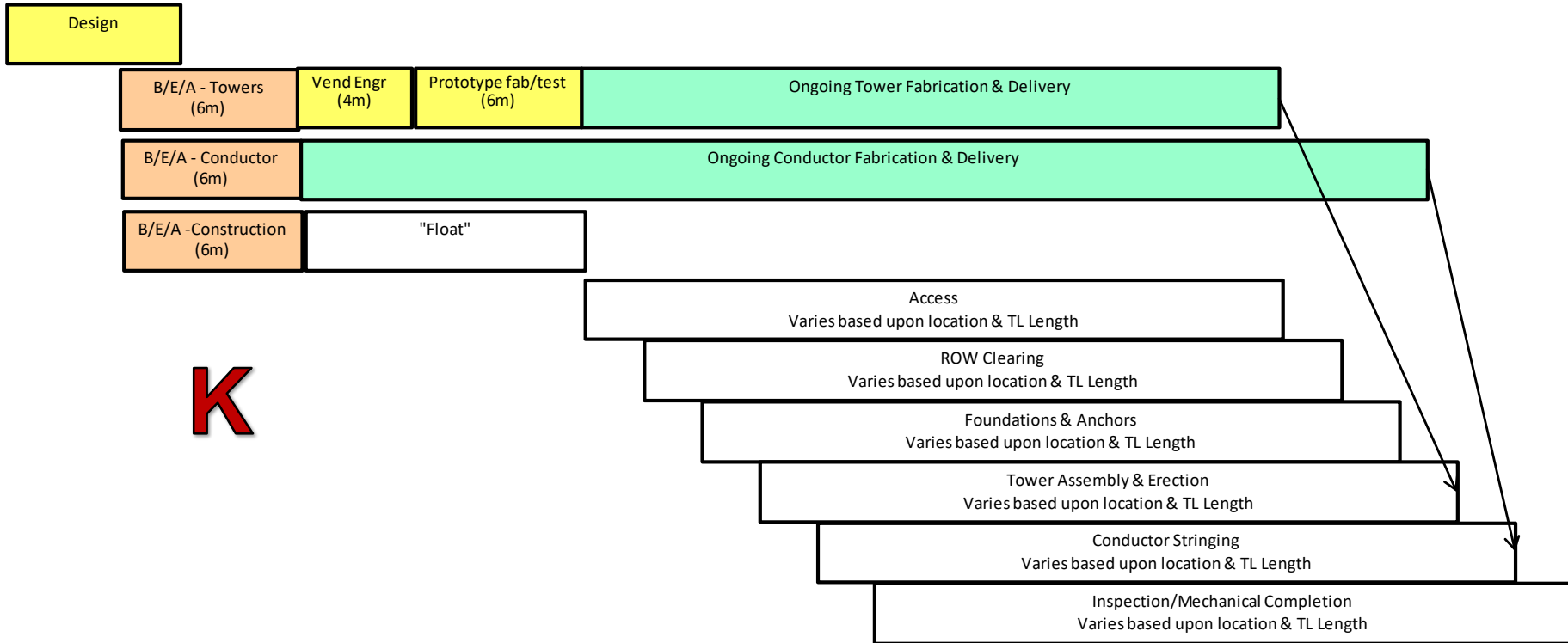


Converter Stations



J

Overland Transmission



K

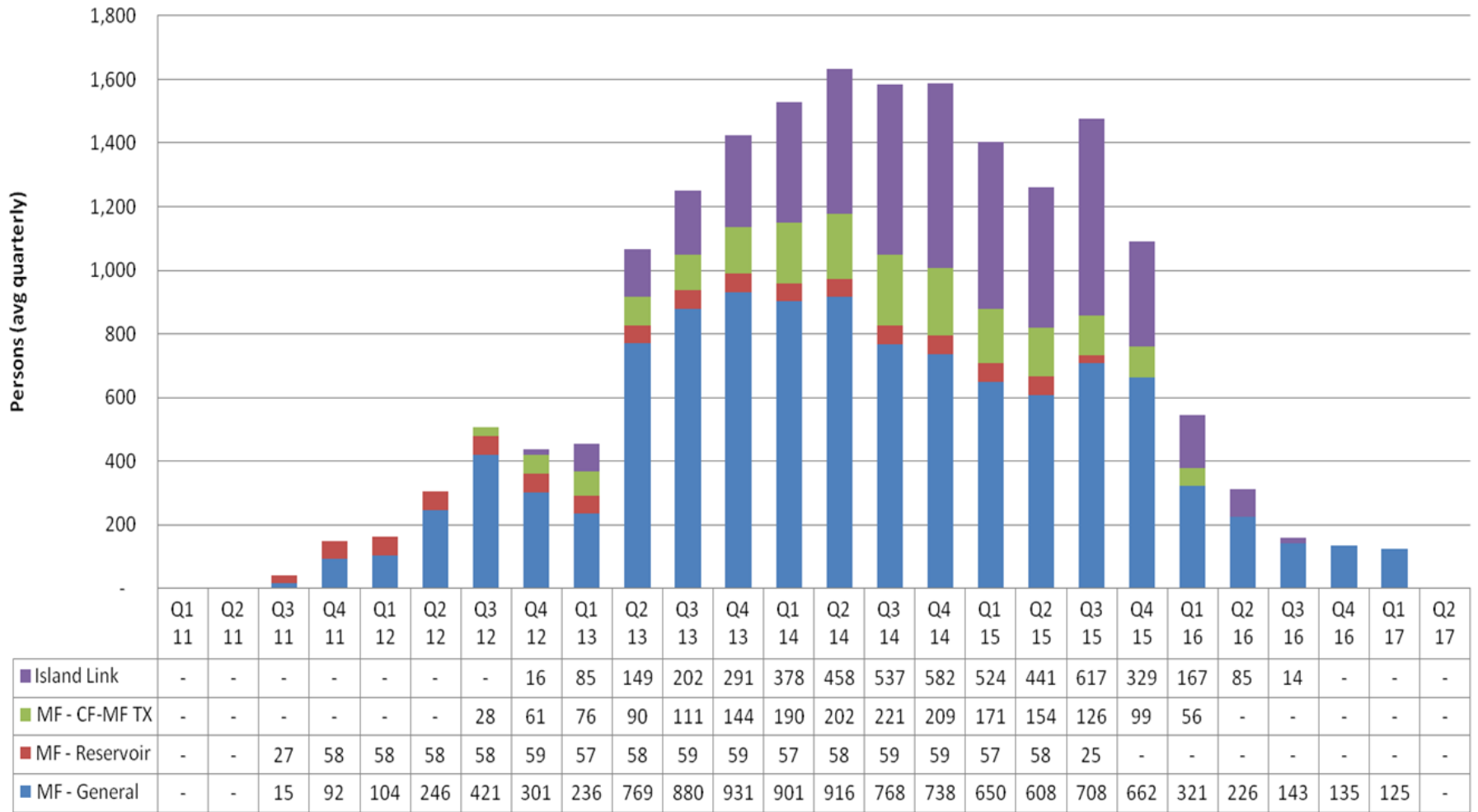
Deterministic Critical Path

Confirm

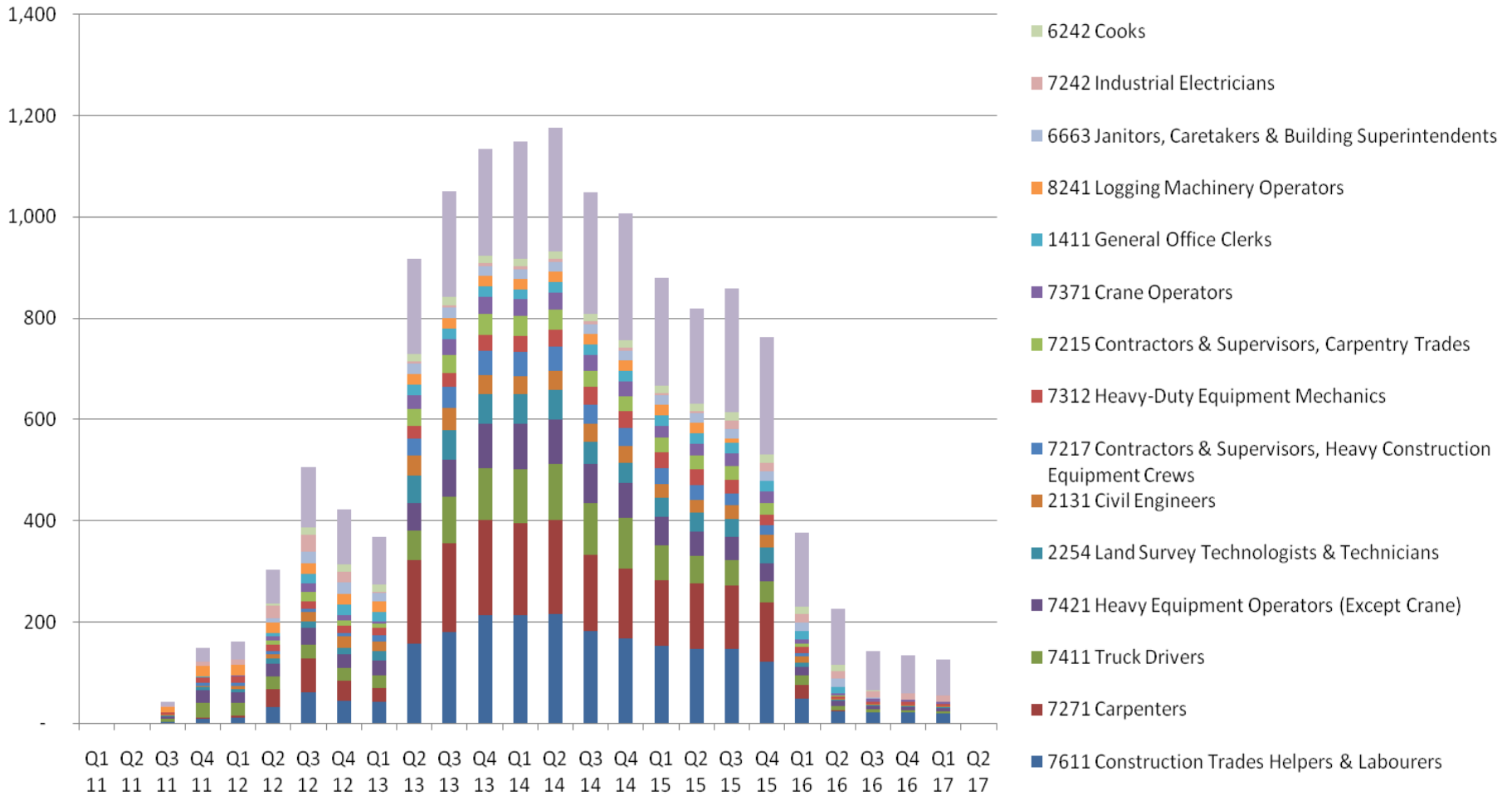
- Award of EPCM Services Agreement & Consultant Mobilization
- Pre-EPCM Site Design & Site Design Finalization
- Critical Design Elements: Main Civil Works, Converter Stations, Overhead Transmission
- Turbines & Generators Contract Award
- Site Access & Development
- Bulk & Final Excavation
- Manufacturing & Delivery of Embedded Turbine Components
- Concreting & Structural Steel related to Turbines
- Contract Award and construction of Converter Stations
- Construction of HVdc Island Link Transmission
- Construction of HVac MF-CF Transmission

- Award of the EPCM contract and the mobilization of the EPCM contractor;
- Pre-EPCM site design for the Muskrat Falls generating site;
- Critical design elements, such as the design package for the main civil works, the SOBI crossing, converter stations, and the HVdc overhead transmission system;
- Turbine model testing;
- The award of the turbine supply contract;
- The manufacturing and delivery of the embedded components for turbine unit No. 1 (specifically, the stay ring);
- Release from both the Generation and Island Link EA processes;
- Development of access to the generation site;
- The final excavation of the powerhouse and intake;
- Secondary concreting and structural steel related to turbine unit No. 1;
- Installation, assembly and commissioning of turbine unit No. 1;
- Commissioning of subsequent turbine units 2 to 4;
- Contracting processes for the overland dc transmission;
- Contract award and detailed design for the SOBI crossing;
- Installation and protection of the SOBI cables; and
- Contract award, construction and commissioning of the HVdc converter stations at Soldier's Pond and Muskrat Falls.

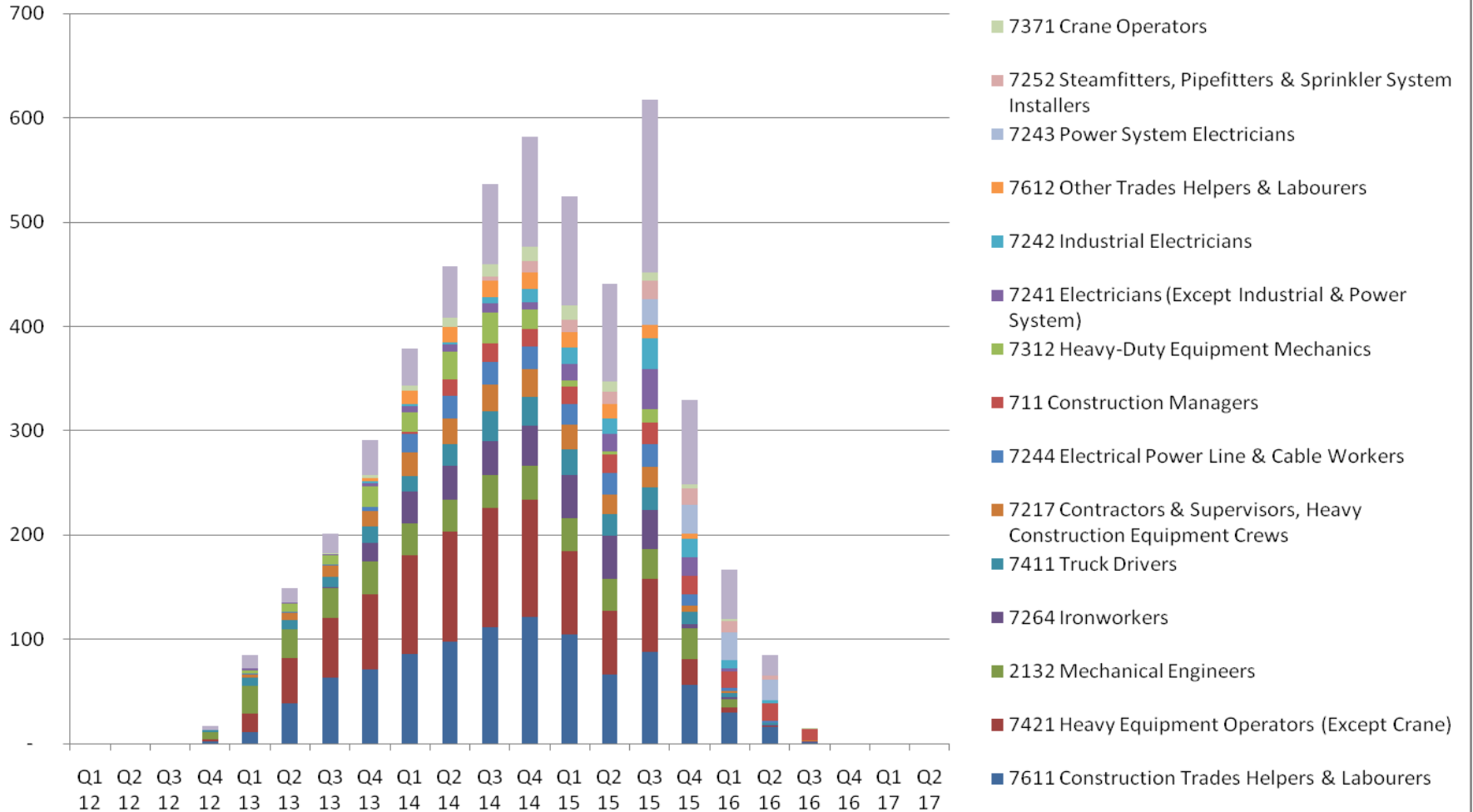
Total Labour Demand - Muskrat Falls and Island Link



Muskrat Falls Trade Labour



Island Link Trade Labour



Implemented Schedule De-risking Initiatives

- Turbine Modeling Testing – Underway
- Accommodation Complex Specifications – Prepared
- LiDAR survey for Overland TL – Complete
- LiDAR survey for MF Site – Complete
- Critical MF and IL Geotechnical surveys – Complete
- Reservoir Preparation Study – Complete
- MF Site Access Road Routing, LiDAR & Geotechnical surveys – Complete

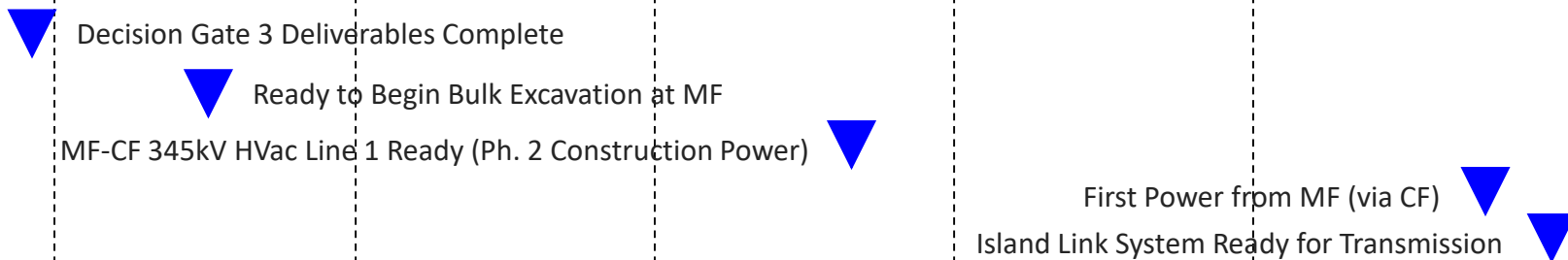
2011 Priorities identified at DG2

- DG 3 Key Deliverables – by 15-Dec-2011
- Finalization of MF Layout & Physical Modeling
- Spillway finalization & design – particularly as impacts Gates
- Confirmation of contracting strategy and packaging
- Collective agreement negotiations
- Overland Tx construction approach, design and contracting
- Reservoir preparation execution strategy
- MF site access to facilitate commencement of Mass Excavation
- Tender Accommodations Complex and Site Services
- Tender bulk excavation works at the Muskrat Falls site
- Tender of supply & install of turbines / generators
- HVdc system studies and converter station specs
- Location & footprint of SOBI transition buildings (key interface)

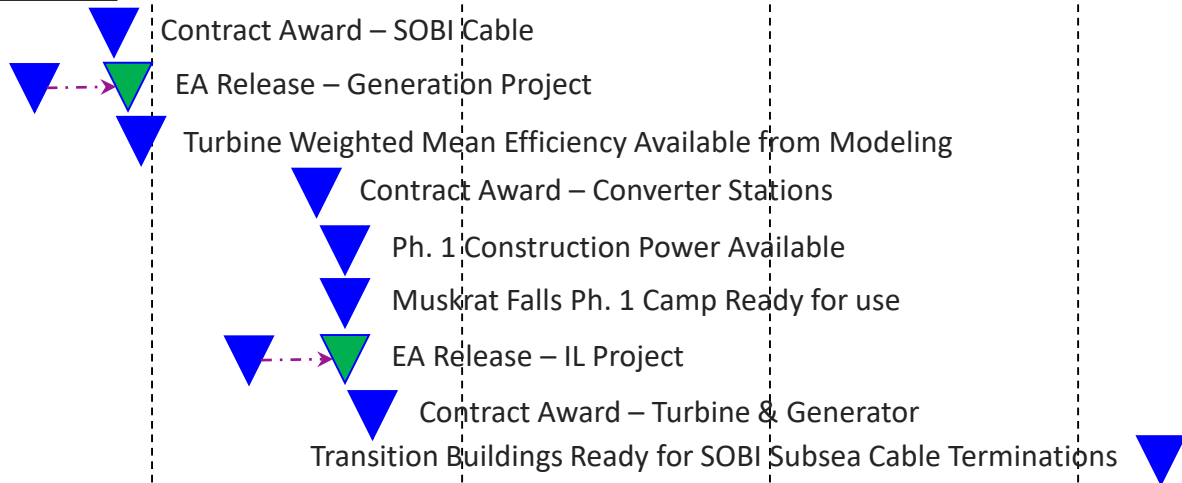
Key Front-End Dates

2011				2012				2013				2014				2015				2016			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Contract Milestones



Key Dates



2011				2012				2013				2014				2015				2016			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

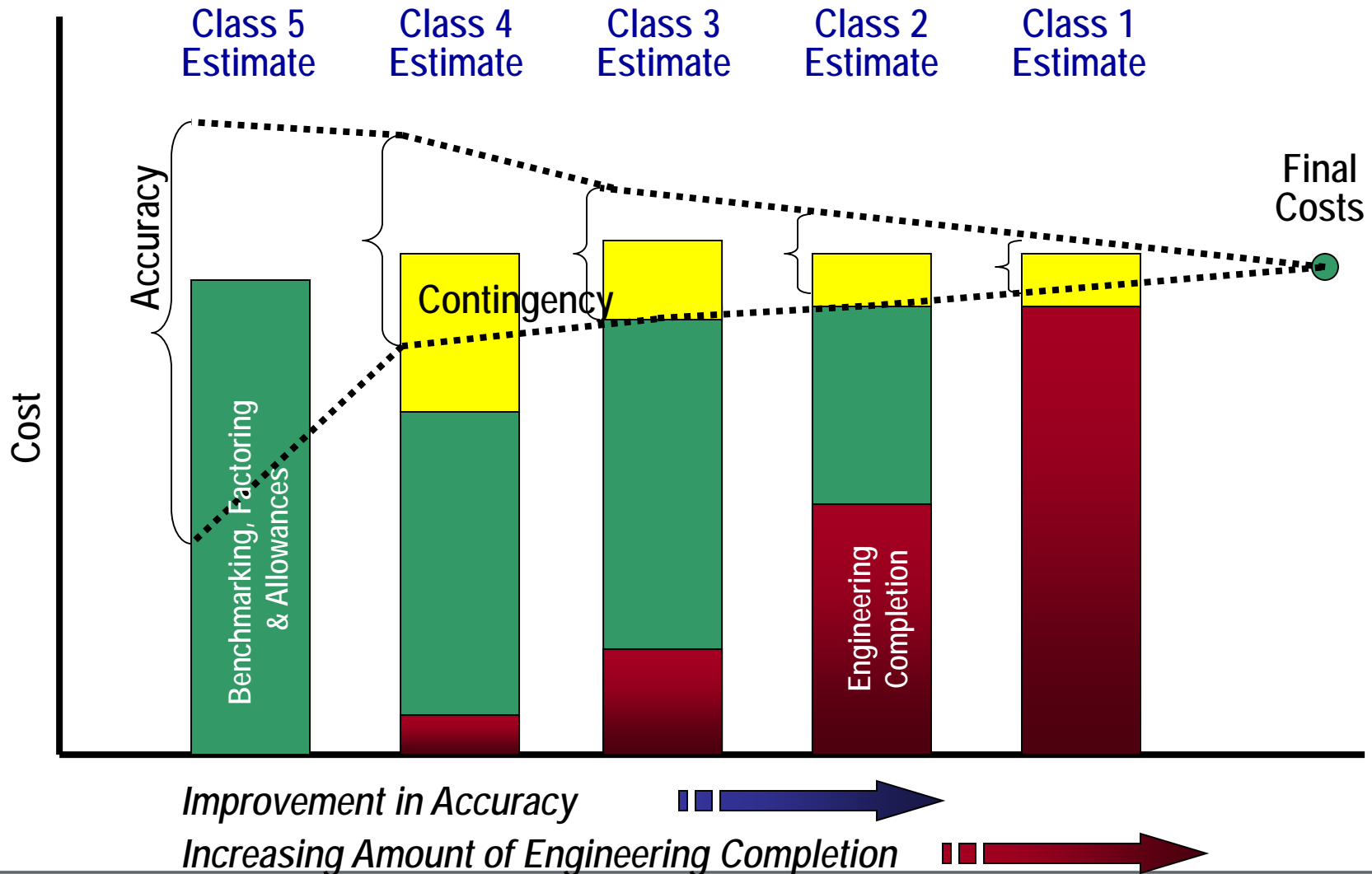
Capital Cost Estimate



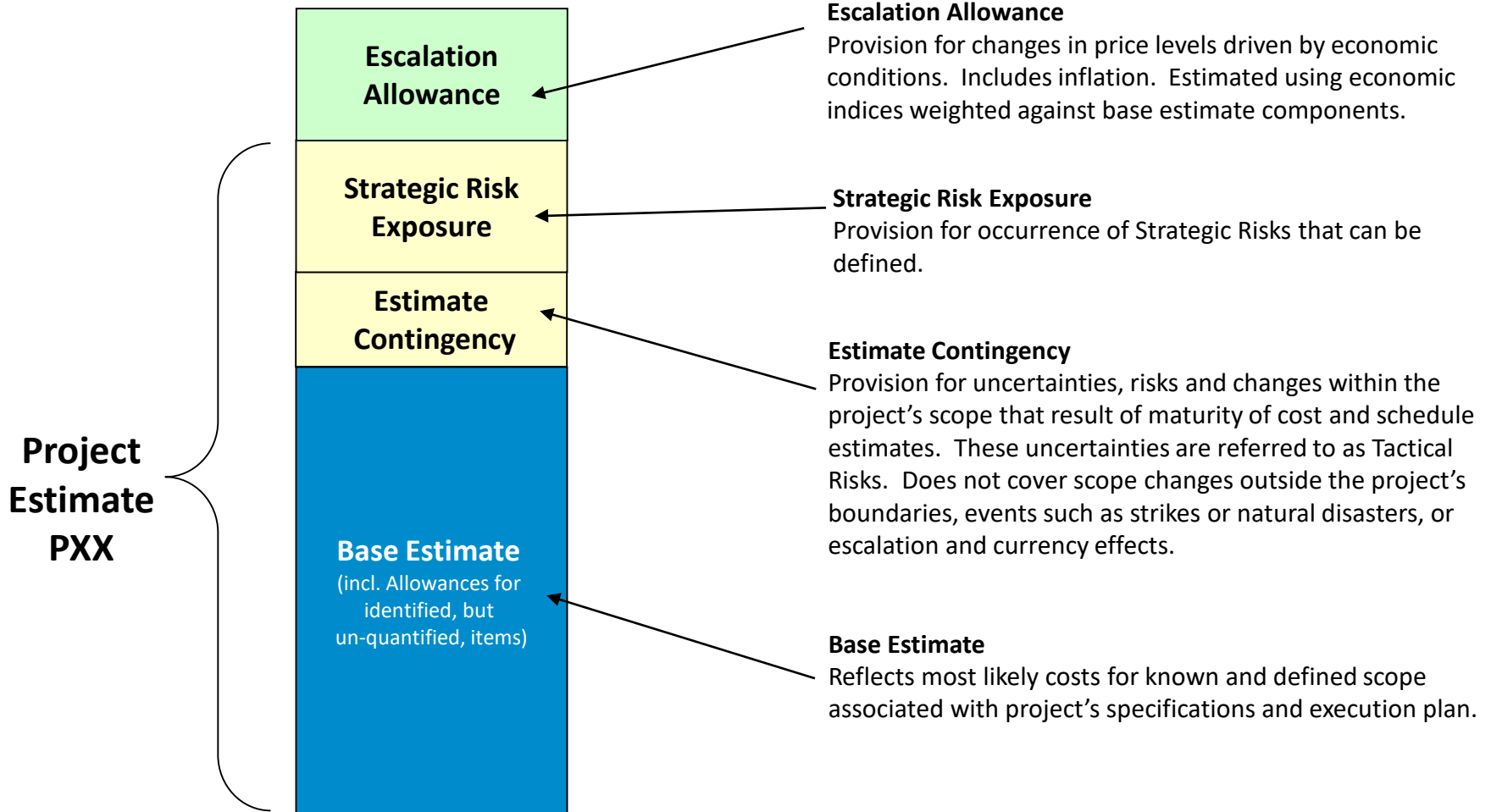
Decision Gate 2 Estimate

- Deterministic estimate – uses a combination of quantity based, unit rate and factored estimate with allowances.
- Commensurate with a AACE International Class 4 estimate classification.
- Leverages extensive estimating work for LCP completed over proceeding 3 years, including input from various third party specialists.
- Estimate uncertainties addressed via a comprehensive risk analysis process.

Estimate Class and Maturity



Project Cost Estimate Components



Base Estimate Elements

DEFINITION

PERFORMANCE



- Location Factors
- Plant Definition
- Major Equipment
- Bulk Quantities
- Design Constraints
- Design Criteria
- Design Standards
- Technology Limits

- Build Sequence and Constraints
- Construction Equip.
- Labor Demands
- Trade Mix
- In-directs
- Support Facilities
- Seasonality

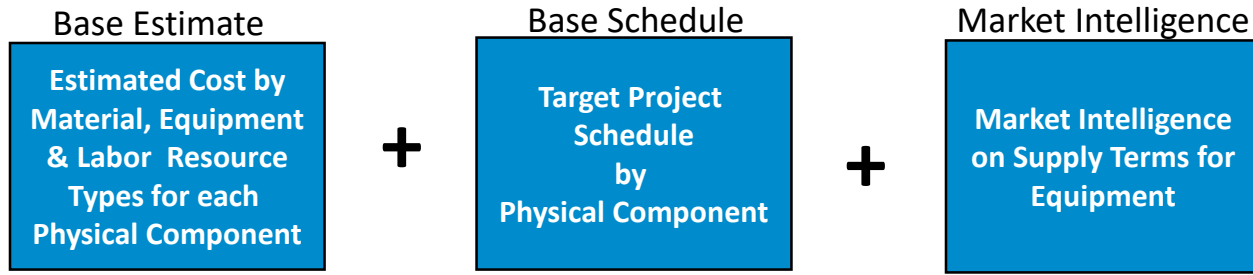
- Labor Rates
- Equipment Rates
- Marine Construction Vessels
- Commodities Rates
- Permanent Equip.
- Materials Cost
- Contracting & Procurement Strategy

- Labor Productivity
- Mobilization Constraints
- Seasonality Impacts
- Equipment Productivity
- In-Directs
- Project Management Resources

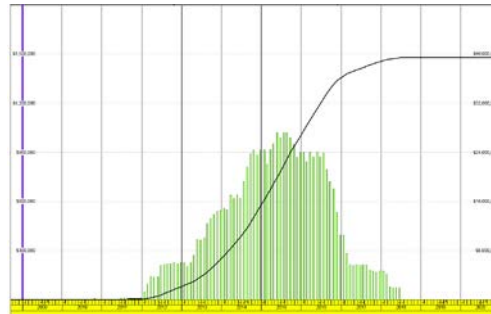
Noteworthy

- Estimate based upon contract package listing.
- Includes detailed build-up of in-directs, in lieu of % of direct.
- Historical as-built productivities for concrete, formwork, tower erection and conductor stringing considered.
- Key construction consumables based upon supplier quotes.
- Consistent with Building Trade / IBEW labor demarcation.
- Labor rates competitive with other East Coast megaprojects
- Permanent equipment items re-quoted late 2009 / early 2010
 - Turbines, submarine cable, transmission towers, insulators, converter stations, transformers
- Fleet and productivity assumptions made for major earth works. Validated by Cat FPC software using know site layout.
- Fleet hourly cost calculated from first principles.
- Cost flow of all major commodities and equipment in-place.

Estimate Cost Flow using Primavera



Schedule Loaded with Resources and Demand Profiles
Producing Cost Flow by Physical Component and Project



Typical Physical Components

- Dam
- Diversion
- Accommodations
- Converter Station

Note:

Subsequent adjustments are then made to Base Schedule in order to generate P50 & P75 schedules and associated cost curves.