From: pharrington@nalcorenergy.com
To: Bown, Charles
Subject: DEck
Date: Monday, August 13, 2012 4:07:12 PM
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Reasons for improved estimate accuracy from DG2 to DG3 Preliminary Draft rev Aug 13 rev 2 no video- NL,NS,Feds.pptx

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Charles

As requested , attached is a preliminary draft of the deck we are working on - It is work in progress and is not the final version , if you forward to others please ensure that they understand that it will change once we have a chance to meet internally and go through line by line.

Regards Paul

Reasons for improved estimate accuracy from DG2 to DG3 Preliminary Draft rev Aug 13 rev 2 no video- NL,NS,Feds.pptx

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Note

This is a preliminary draft version, some slides are currently being reworked and has not been fully internally checked

DG3 Estimate Overview

13 August-2012

Boundless Energy

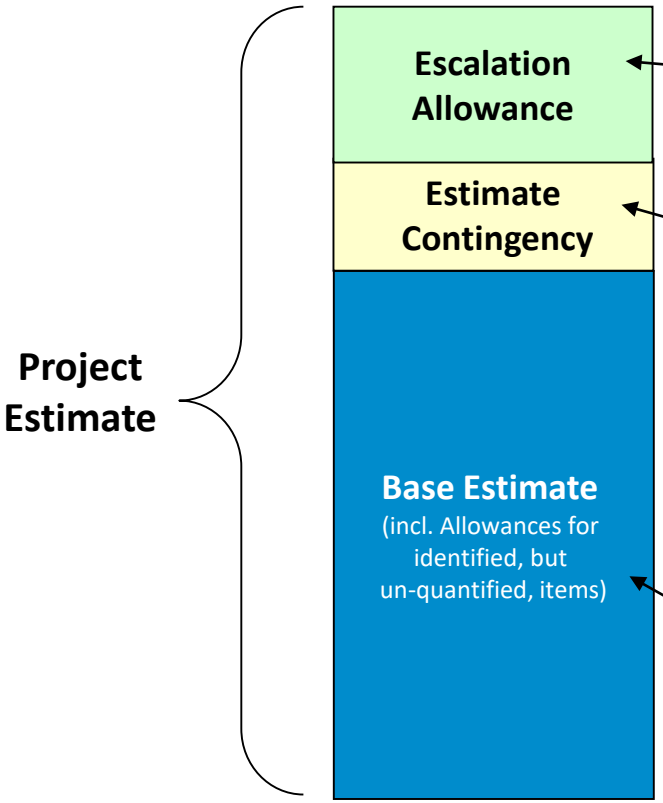
nalcor energy

LOWER CHURCHILL PROJECT

Preliminary Draft

Confidential and Commercially Sensitive

Cost Estimate is comprised of 3 Primary Components



Escalation Allowance
Provision for changes in price levels driven by economic conditions. Includes inflation. Estimated using economic indices weighted against base estimate components.

Estimate Contingency
Provision made for variations to the basis of an estimate of time or cost that are likely to occur, that cannot be specifically identified at the time the estimate is prepared but, experience shows, will likely occur. It is not meant to cover scope changes outside the Project's parameters, events such as strikes or natural disasters, escalation or foreign currency impact, or changes that alter the basis upon which the control point for management of change as been established as captured in key project documents (e.g. basis of design, project execution plan).

Base Estimate
Reflects most likely costs for known and defined scope associated with project's specifications and execution plan.

Estimate Leverages Extensive Information

Input 1		Input 2		Input 3		Input 4		Output
Definition Factors (Scope)	+	**Construction Methodology & Timeline Factors**	+	**Price Factors**	+	**Performance Factors**	=	**Base Estimate**

- ❑ Design Criteria & Specifications
- ❑ General Arrangements & Layouts
- ❑ Design Drawings for major components – towers and hardware
- ❑ MF rock and concrete quantities from 3D CAD
- ❑ Master Equipment List
- ❑ Cable List
- ❑ Material Take-offs for Construction Bulks
- ❑ Equipment Specifications
- ❑ Geotech surveys
- ❑ WBS & Cost Codes

- ❑ Construction Philosophies
- ❑ Construction Execution Plan
- ❑ Constructability Reviews
- ❑ Construction Schedule
- ❑ Logistics and Access, incl. freight forwarding & marshaling yards
- ❑ Contract Package Dictionary
- ❑ Org. Design and Staff Plans
- ❑ Construction Equip. Types
- ❑ Labor Demand
- ❑ Labor Demarcation
- ❑ In-directs Strategies
- ❑ Site Services
- ❑ Pre-Fabrication Plans
- ❑ Crane & Access Studies
- ❑ Support Facilities
- ❑ Material Sourcing Strategies
- ❑ Seasonality Constraints
- ❑ Permit Register

- ❑ Labor Agreement
- ❑ Construction Equip. Rates
- ❑ Bid Analysis – T/G, SOBI Cable, Tower Steel, Accommodations, Road
- ❑ Budgetary Quotes – various equipment
- ❑ Site Services Costs – catering, air transport
- ❑ Construction Bulks Prices – Rebar, Cement, Diesel, etc.
- ❑ Helicopters and Aircrane
- ❑ Contracting Market Intelligence – overhead and profit
- ❑ Foreign Exchange Rates

- ❑ Crew Make-up and Assignments
- ❑ Task durations
- ❑ Workface Restrictions
- ❑ Labor Productivity & Benchmarks
- ❑ Mobilization Constraints
- ❑ Work Front Stacking
- ❑ Seasonality Impacts
- ❑ Equipment Productivity
- ❑ In-Directs Usage
- ❑ Offsite Fabrication

- ❑ Estimate organized by Project, Physical Component and by Contract Package
- ❑ Documented Basis of Estimate
- ❑ Foreign Currency Demand
- ❑ Person hours
- ❑ Trade demands
- ❑ Cash flows

DG3 Estimate Summary

LCP Phase 1 (Excluding Maritime Link)
DG3 Estimate Summary (millions Jan 2012 CDN $)

	MF	LTA	LITL	Totals
Base Estimate	$2,511.92	$601.31	$2,359.61	$5,472.84
Contingency	$226.69	$54.83	$86.48	$368.00
Escalation Allowance	$162.54	$35.44	$163.66	$361.64
Totals	$2,901.15	$691.58	$2,609.75	$6,202.48

% of Total	46.8%	11.2%	42.1%	100.0%

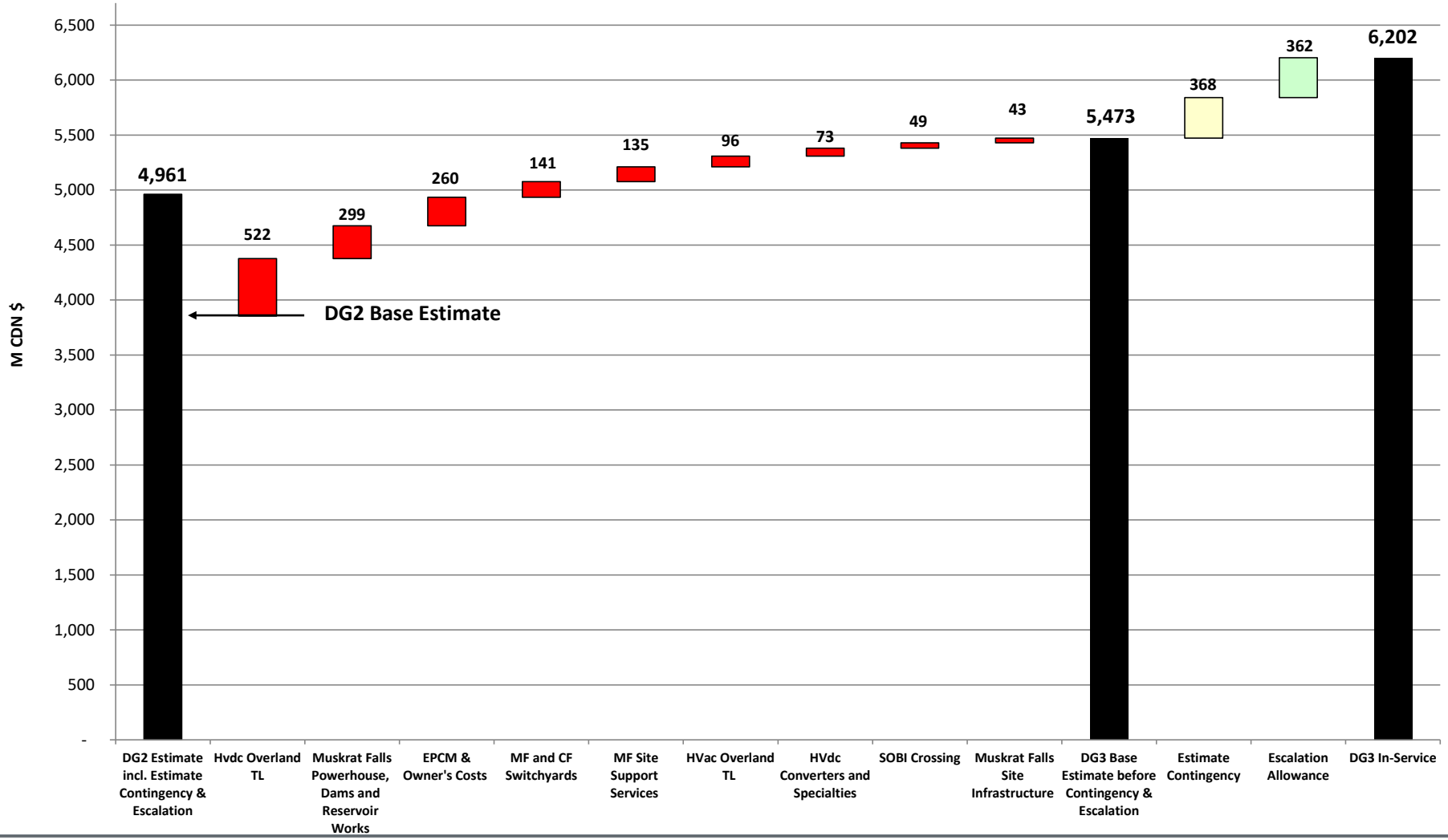
Note

1. MF quantities are well established however production rates could be less than planned, geotechnical issues and support services costs have resulted in the recommended contingency
2. LTA contingency is driven largely by increased construction risks associated with working at an operational switchyard(Churchill Falls)
3. LITL contingency is lower than both MF and LITL because there is a productivity/weather downtime allowance built into the base estimate and the SOBI cable costs are now known and include installation with opportunities for cost savings identified

Why does the estimate change between DG2 and DG3?

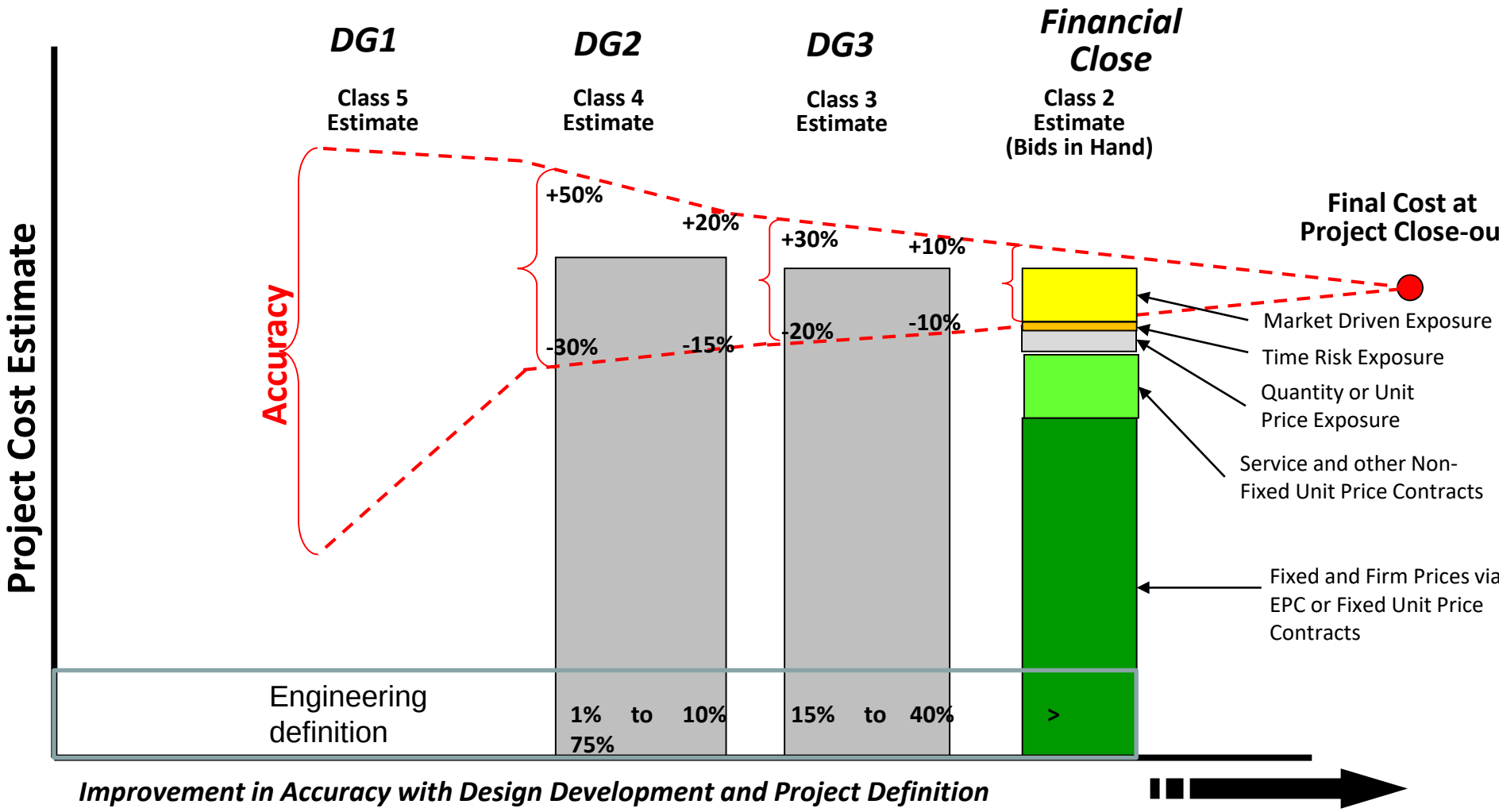
- Main reason is the amount of project definition on which to base the estimate.
- Site investigation, detailed engineering , computer/physical models all follow the DG2 decision on the selected development alternative
- You need to carry out the detailed work in order to have a mature DG3 estimate, costs will change with better definition of the selected alternative

Estimate Changes Since DG2



Note: Estimate changes since DG2 include 2010 to 2012 overnight adjustment based upon 4.6% increase from Q1-2010 to Q4-2011 for MF and 4.0% for LITL and LTA.

Establishing Sound Cost Basis



What is the difference between DG2 and DG3 input data?

- A DG2 decision is made based on limited engineering definition < 5%
- It is not recommended practice, economic or practical to advance into detailed engineering with all alternatives
- The DG2 decision is used to select the alternative to move forward with
- It is only after spending the time, effort and energy after DG2 on the selected alternative that the final quantities of rock, material, concrete, steel, person hours are known based on site investigation work, analysis and detailed engineering > 45%
- Market conditions known at DG2 change and are firmed up after DG2 with actual contract bids
- The DG3 estimate contains actual firm contract prices and reflect the prevalent market conditions
- Moving ahead with the selected alternative involves significant cost investment to arrive at a DG3/Sanction Quality estimate based on firm quantities, person hours and design basis –LCP has incurred ~ $155M since DG2 to advance our understanding of the project and associated costs

Examples of Engineering work performed since DG2

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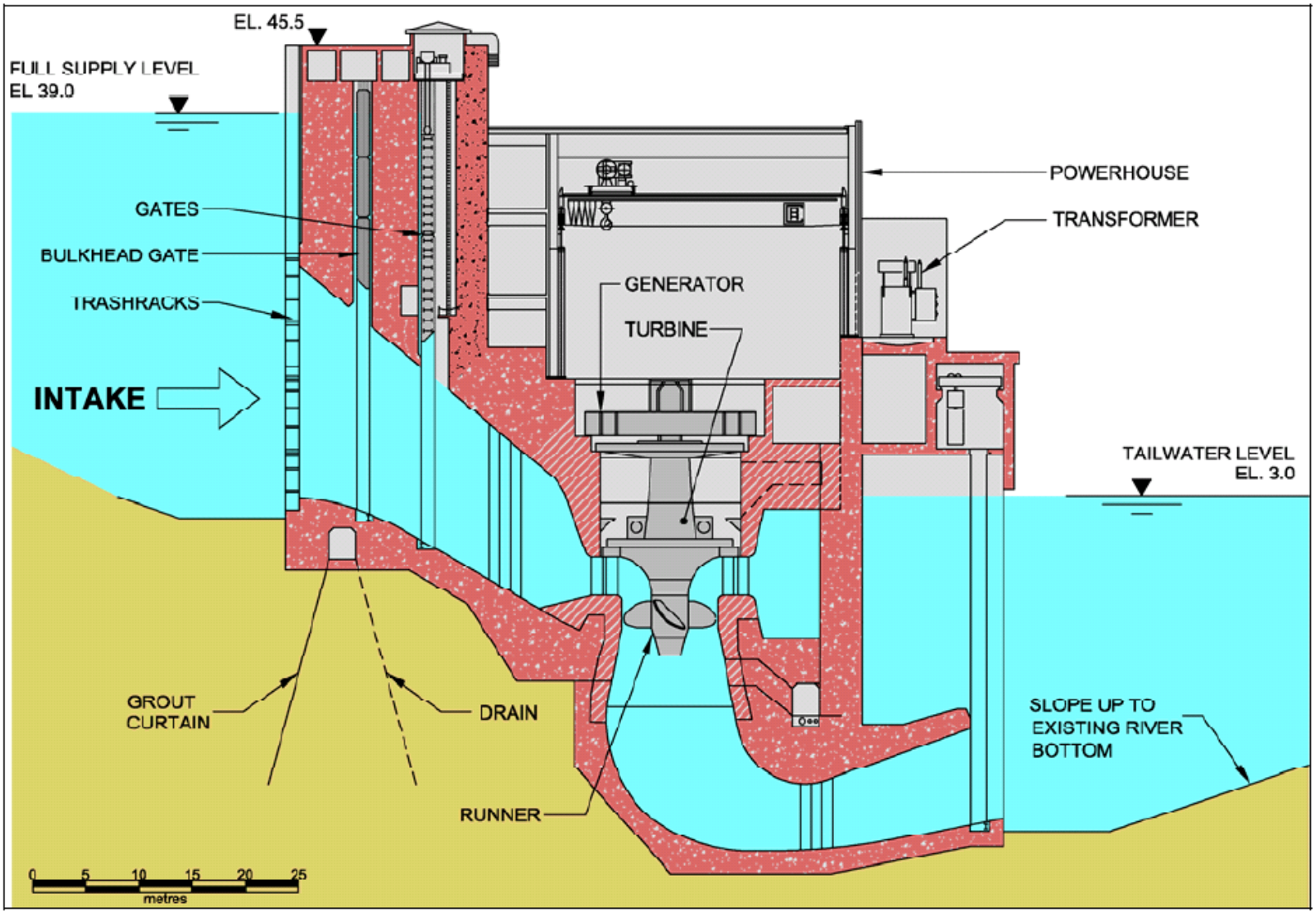
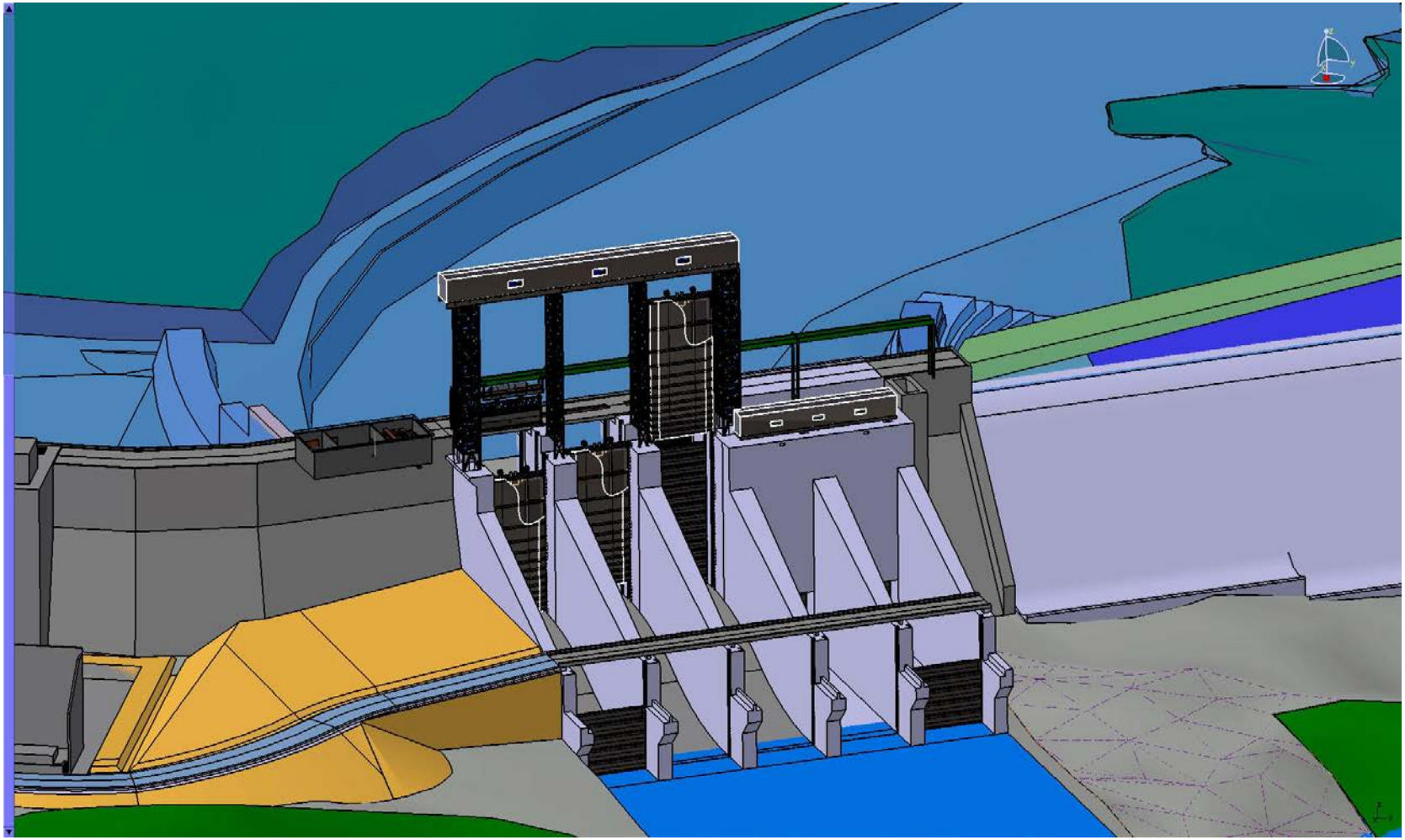
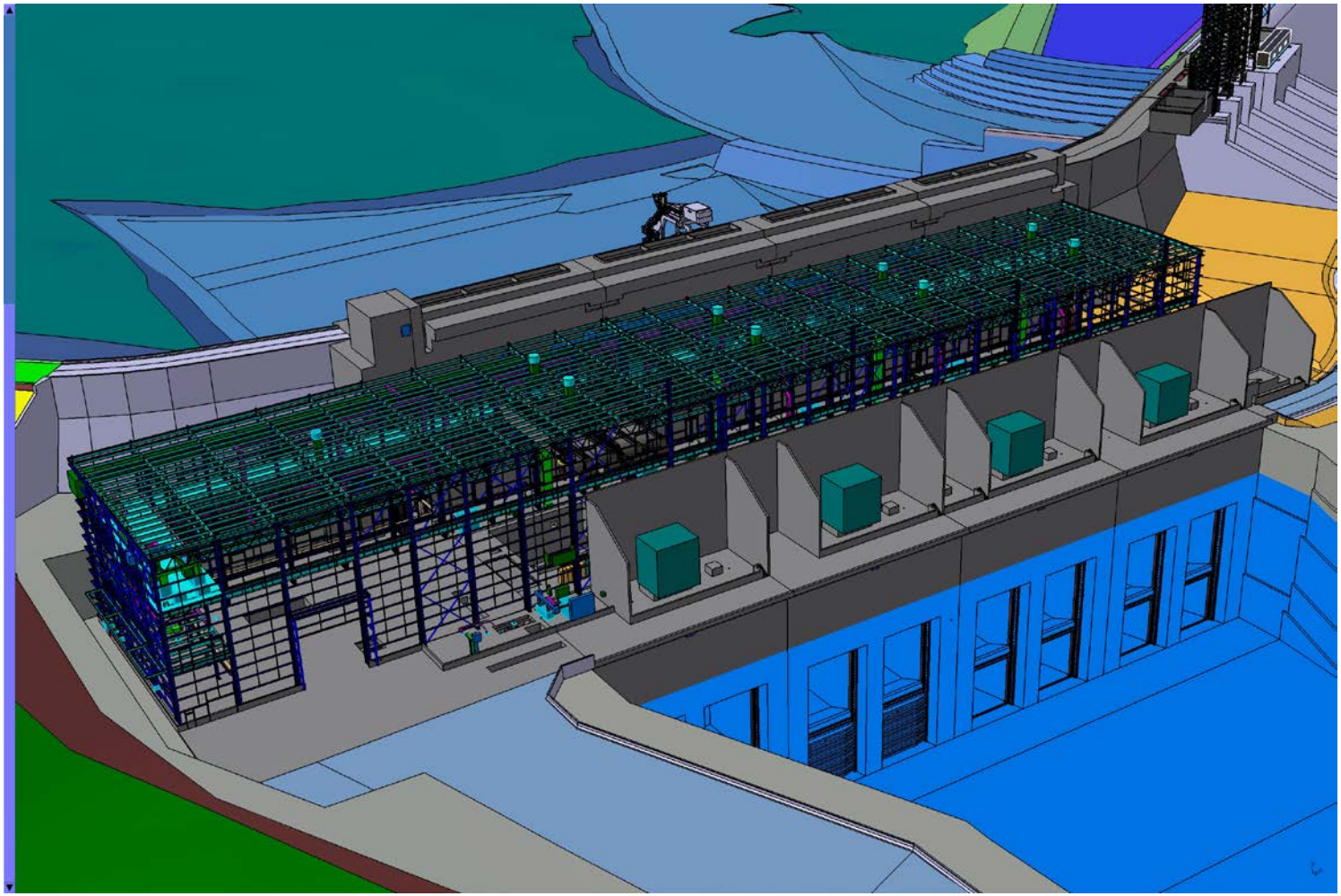

EL. 45.5
FULL SUPPLY LEVEL
EL 39.0
GATES
BULKHEAD GATE
TRASHRACKS
INTAKE
POWERHOUSE
TRANSFORMER
GENERATOR
TURBINE
TAILWATER LEVEL
EL. 3.0
GROUT
CURTAIN
DRAIN
RUNNER
SLOPE UP TO
EXISTING RIVER
BOTTOM
0 5 10 15 20 25
metres

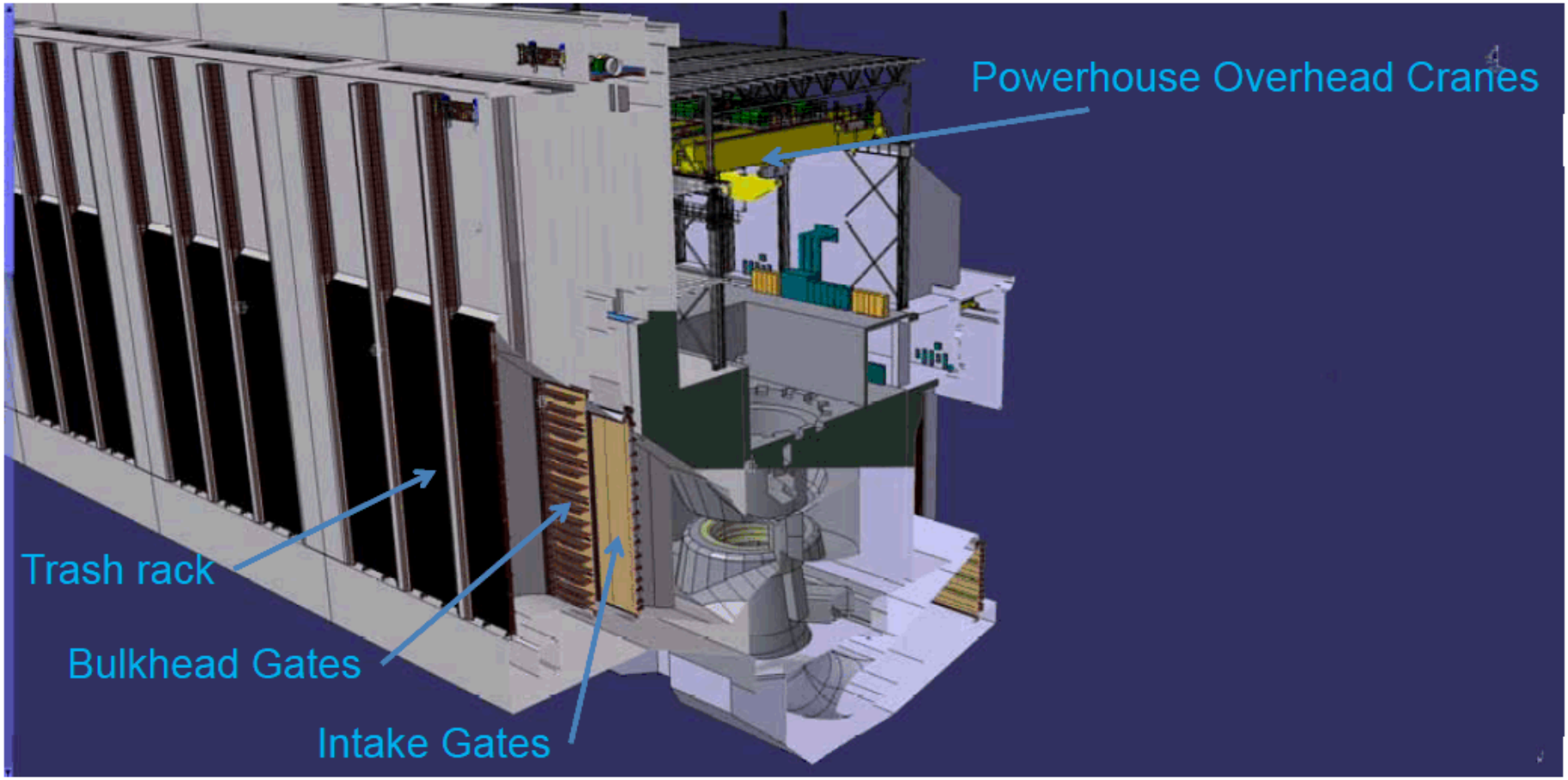
Gated Spillway



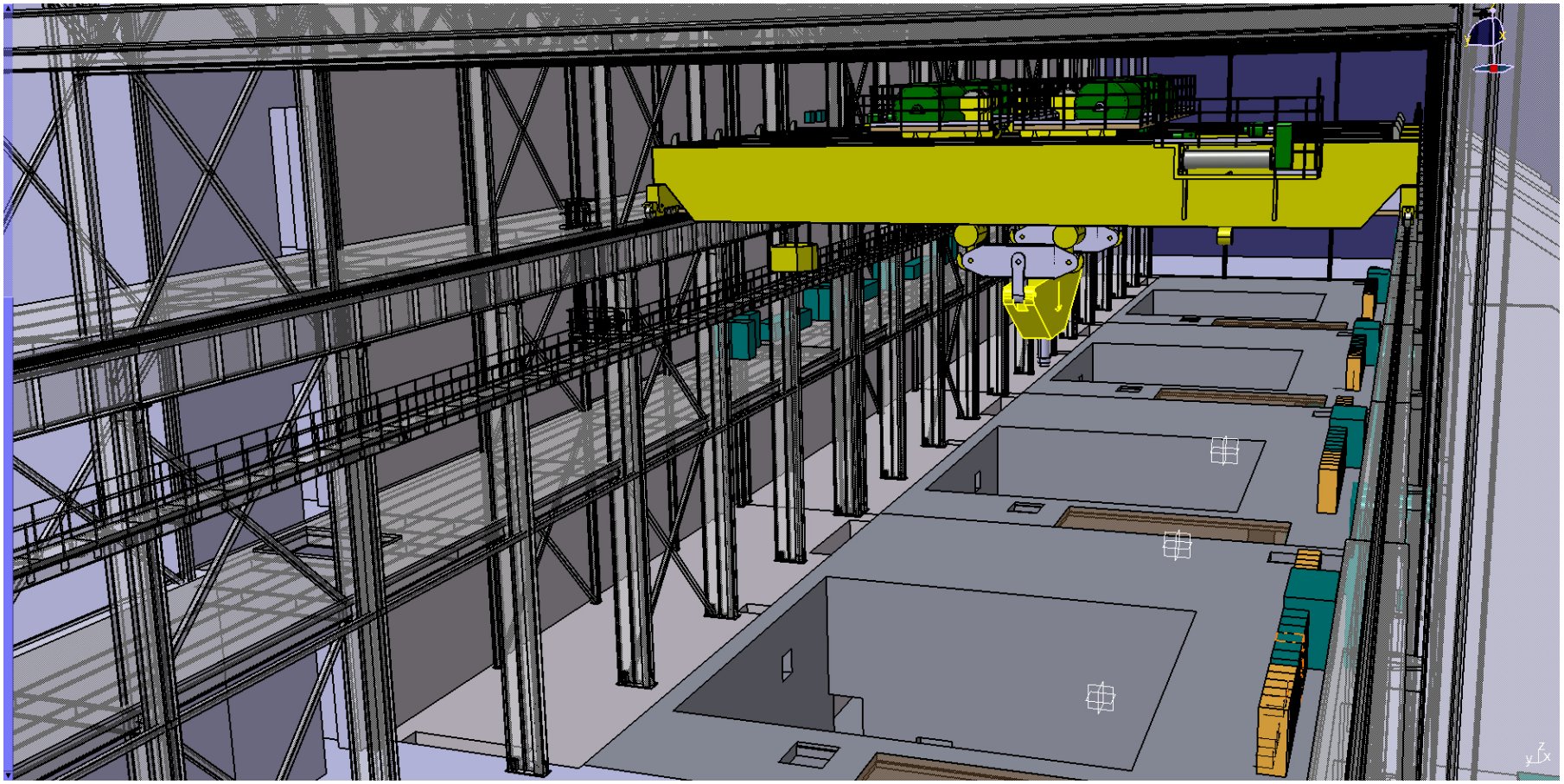
Superstructure under Construction



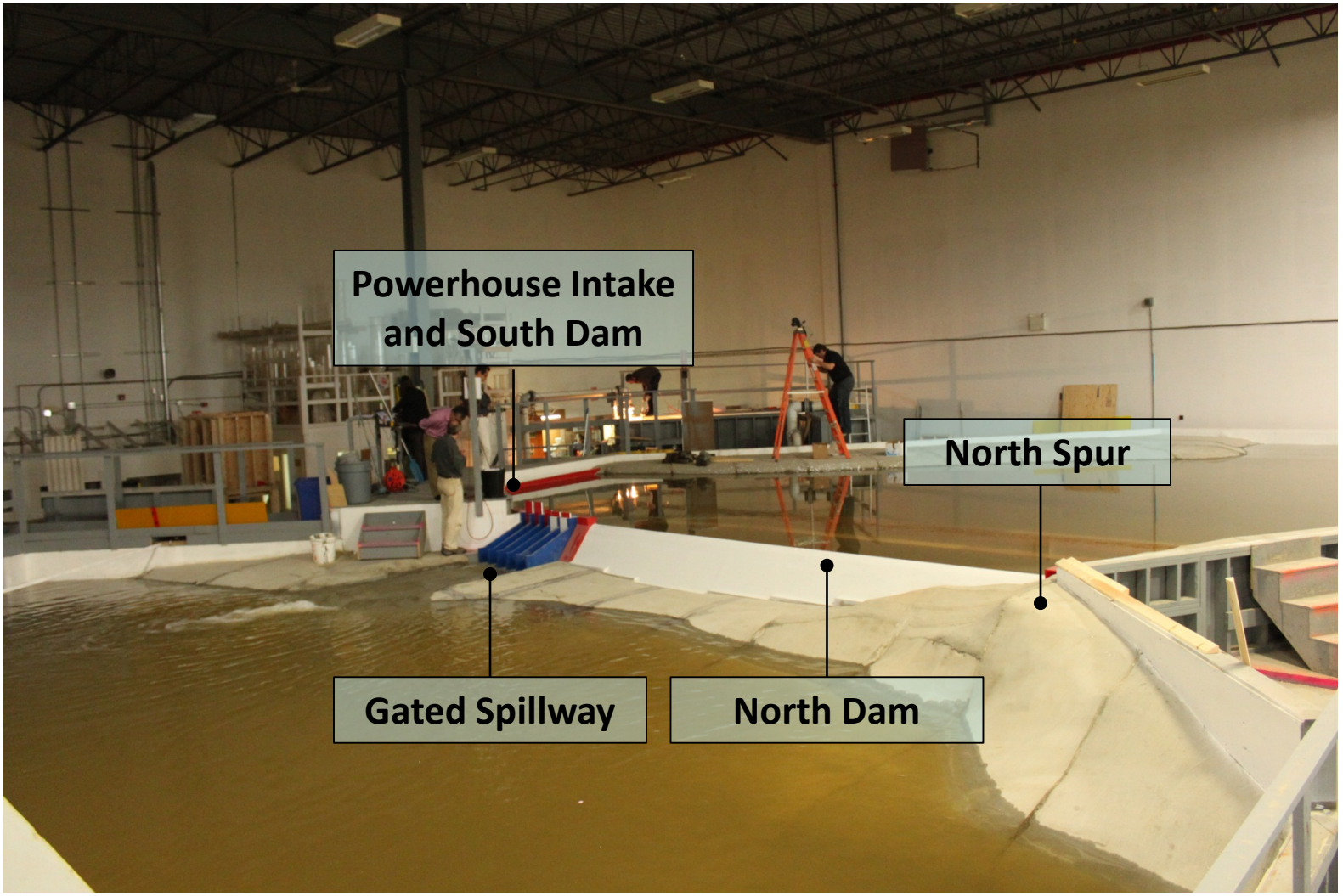
Powerhouse Cross-Section



Powerhouse Cranes – 2 x 350 tons Working in Tandem



The Model Components



Other Work Performed Since DG2

- Geotechnical site investigation work at all switchyards and converter station and electrode site locations
- Hvac transmission engineering work completed, route and towers selected
- HVdc transmission engineering work well advanced, meteorological work carried out, routing nearing completion, tower families selected, conductors selected
- System planning work to integrate with existing island system completed
- SOBI Pilot hole drilled to verify drill rates and costs
- SOBI subsea cable supply and install contract ready to award
- Turbine and Generator sets contract ready to award
- Early works contracts awarded, clearing, road construction, construction power

Comparison to other Hydroelectric Projects

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Wuskwatim Comparison

Year	20003	2004	2005	2006	2007	2008	2009	2011
Estimated Cost	$988M	$1.043B	$1.135B	$1.351B	$1.595B	$1.591B	$1.591B	$1.566B

EA Release Aboriginal Agreement signed Start of Construction

The forecast cost is 16% greater than the 2006 estimate

The 16% cost increase since start of construction is primarily driven by labour rates – Manitoba has a Province wide agreement on rates rather than Project specific labour agreements. The rates established had to be increased to attaract and retain the trades required.

Both Lower Mattagami (OPG Project) and Lower Churchill Project have learned from this and have estimated labour rates and site conditions which mitigate this risk

MF Capital Cost is Driven by favourable Construction Characteristics

Key Element	Muskrat Falls Site Characteristics
Geotechnical Conditions	• Competent bedrock (Canadian Shield) exposed / near surface • Minimal overburden to remove and dispose • Conditions validated by comprehensive site investigations, thus limited exposure with respect to quantity growth

Physical Layout	• No peripheral structures (i.e. dykes) required to create the Reservoir– basically "filling up the river valley", leveraging Churchill Falls reservoir – no land purchase issues
	• Reliable and predictable flows leading to smaller variations in operating water levels
	• All power structures located at one main site
	• Simple / robust / conventional designs for major permanent structures (Intake , Powerhouse, Spillway, Aux. Dams)
	  • Conventional or roller-compacted concrete founded on bedrock
	  • Generally low-profile dam structures (30 to 40 m high)
	• No underground works (MF has surface powerhouse)
	• No temporary spillway facilities to be constructed
	• Diversion uses existing topography and permanent structures (i.e. Spillway) rather than expensive temporary structures (e.g. Diversion Tunnels)
	• Conventional equipment (T&G sets, gates, cranes)
	• Access by road from Trans-Labrador Highway

Constructability	• All construction materials primarily sourced from site excavations • Very good material balance leading to minimal excess material / spoils • Mostly conventional concreting methods and equipment, in dry conditions

Lower Churchill Project Quantities Generation

- Powerhouse intake and Spillway has :
  - Mass Excavation of 2.5M m3
  - 390,000 m3 of concrete
  - 200,000 m2 of formwork
  - 57,000 tonnes of rebar
  - 88m high and 225m wide (the Peace Tower is 92.2m high)
- Dams and Cofferdams have:
  - 895,000 m3 material
- Roller Compacted Concrete :
  - 226,000 m3 RCC
- North Spur has:
  - Overburden and rock excavation of 700,00 m3
  - Rockfill of 1M m3

Lower Churchill Project Quantities Transmission and Reservoir

- AC transmission
  - 490 kms, 1280 towers
- Dc Transmission
  - 1079 kms, 3642 towers
- Reservoir
  - 1,800 hectares
  - 157kms of roads
  - 390,000 m3 of merchantable wood

- The quantities involved are well understood and have been included in the DG3 estimate

HVdc Overland TL

1. Operating voltage optimization (320 to 350kV) – less losses – results higher towers and different conductor
2. Ice loading criteria and physical data collection –results in more robust towers
3. Detailed line routing and construction methods, longer route and more difficult access (e.g. helicopter construction)
4. Definition of ROW Clearing Scope – approx. $130M
5. Increased Labor cost
6. Increased Material cost – budgetary prices or bids for all material
7. Material handling cost – marshalling yards and shipment
8. Final route design was 30 kms longer than at DG2

MF Powerhouse, Intake, Dams and Reservoir

- Layout / design change to resolve:
  1. Hydraulic flow conditions for turbines
  2. Stability of Intake Structure
  3. Operability of Spillway Gates in winter
- Results in significant increase in concrete quantities, thus Materials and Person-hours which is the major cost driver for MF.
- Changes identified with computer model were subsequently confirmed with Physical Model built in Edmonton.
- Secondary drivers include general material costs, batch plant, etc.

EPCM and Owner Cost

- Primarily driven by the highly competitive market in engineering and procurement that has developed in Canada and NL since DG2 compounded by limited availability of hydro/transmission specialists:
  1. Market conditions require a change from an Integrated to EPCM Model
  2. Market conditions for engineers and technologists in the Province have driven rates up above that allowed for in the DG2 estimate
  3. Engineers, specialists and project management personnel brought in from out of Province to meet the project demand with associated additional costs, travel, living allowance, project uplift
  4. Increase the estimated resources for Construction Management to manage and provide oversight of the contractors.
  5. Rates for EPCM O/H and Profit were previously estimated, now based upon executed contract.
  6. Additional carrying costs associated with delays to Environmental Assessment process and legal costs associated with legal challenges.
  7. Additional unplanned reviews by PUB , MHI and Navigant

MF and CF Switchyards

- Including:
  1. Finalization of Single-Line Diagrams for Switchyards
     - 735kV switchyard, working in a brownfield site results in additional costs.
     - Geotechnical data following site investigation work
  2. Requirement to establish site services support at CF for 2+ years
  3. Sparing requirements – now established and included
  4. Material prices
  5. Logistics / transport cost for heavy lift items (i.e. transformers)

MF Site Support Services

- Primarily driven by the highly competitive market in Camps and services that has developed in Canada and NL since DG2 Including:
  1. Operating costs for increased person-hours of construction effort for Muskrat Falls
  2. Market costs for services such as catering and housekeeping
  3. Laboratory and Surveying Scope increase for larger, more complex MF plant
  4. Medical and security requirements
  5. Increased Cost of services such as ground transportation, drug and alcohol testing, pre-employment medical screening, road maintenance, vehicles

HVac Overland TL

- Including:
  1. Detailed line routing and construction methods resulted in detailed understanding of ROW clearing scope
  2. Increased Labor cost
  3. Increased Material cost – budgetary prices or bids for all material are now in hand and are higher than estimated at DG2
  4. Increased support services costs driven by highly competitive market in Canada regarding– marshalling yards, catering, camp, travel, medical support, etc.

HVdc Converters & Specialties, and Island Upgrades

- Including:
  1. Operating voltage optimization (320 to 350kV) resulted in required stability with existing island system ,less line losses which followed detailed system planning studies carried out post DG2
  2. Increased scope of Holyrood Conversion for Synchronous Condenser support
  3. Finalization of Electrodes Sites
     - The electrode line length in Labrador was increased to the SOBI in order to achieve the required technical grounding requirements, site investigation work to determine this was post DG2.
  4. Requirement for Indoor Cable Transition compounds to reduce salt contamination risk
  5. Redundancy/reliability requirements resulting in additional cable switching facilities to facilitate remote energization of the spare cable

SOBI Crossing

- Including:
  1. Final project definition and cable routing
  2. Confirmed cable supply / install prices from RFP
  3. Confirmed ice protection requirements for shoreline and seabed
  4. Actual HDD drilling rates from 2011/12 pilot program

MF Site Infrastructure

- Including:
  1. Scope growth
     - Requirement to replace existing forestry access road, the condition of this road was found to be unsuitable when work started
     - Increase in construction power load following study work
     - Construction telecommunications
  2. Movement of MF Accommodations Complex due to poor geotechnical issues at DG2 location
  3. Allowances for offsite access upgrades – port facilities and bridging for movement of heavy items
  4. The highly competitive market conditions for accommodation complexes across Canada

Contingency Recommendations

- Westney engaged to conduct risk assessment in late May / early June with Project Team. Key Findings:

1. *The scope for the project is well defined and represents design development consistent with project sanction. Considerations, such as likely geotechnical conditions and quantity variations due to further design development, were quantified based on the experience of the project team and used as a basis for assessing the possible outcomes.*

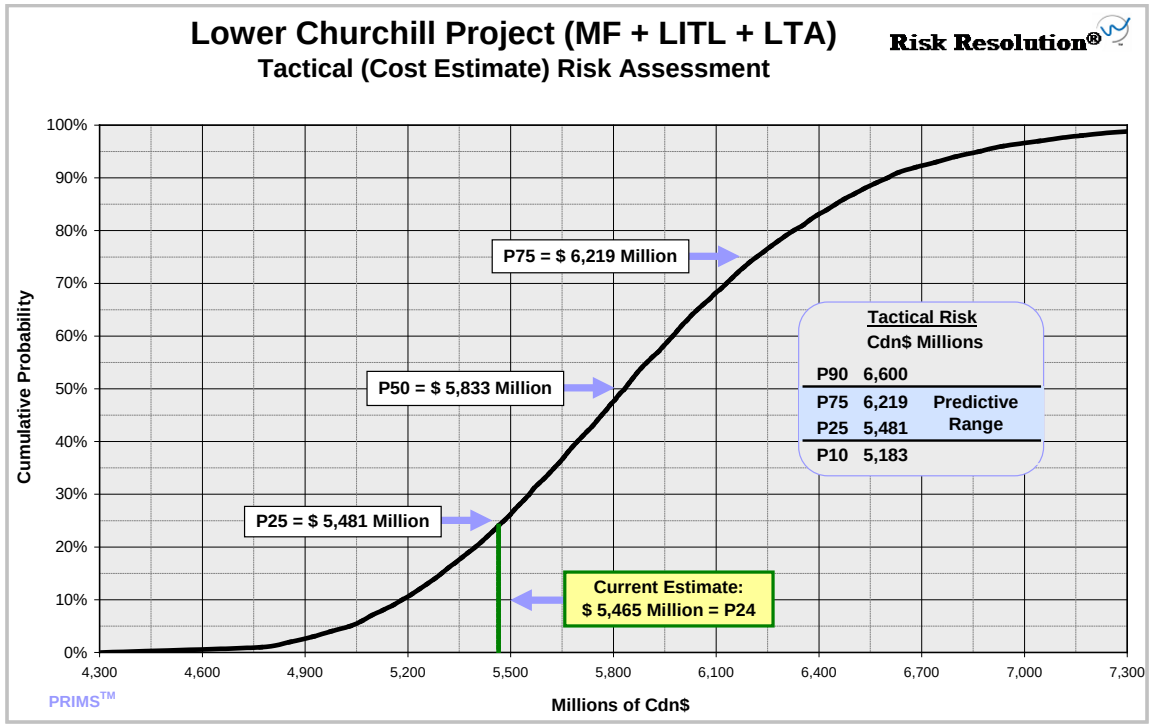
2. *The estimate and quantification are consistent with the requirements of project sanction. In many cases, pricing was based on actual bids and budgetary quotes. "Check" estimates were developed by industry experts for key areas, including the Muskrat Falls powerhouse and dam works. Other pricing was benchmarked against representative projects. The effects of weather, labour /skills availability, and supervision were also considered and/or benchmarked. Overall, this project's degree of design development, definition, and methodology is consistent with an AACEI Class 2 estimate.*

3. *The estimate, plus an amount to reach the P50 on the results curve, should represent the cost at which the project can be executed according to the plan exclusive of external uncertainties.*

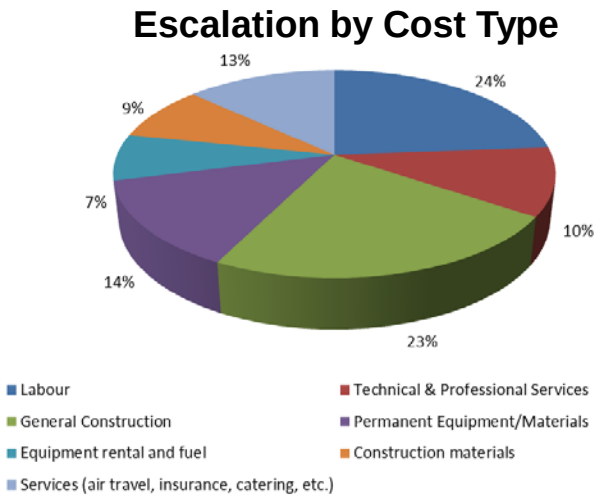
4. *A P50 contingency is $368 million which equates to 7% of the estimate.*

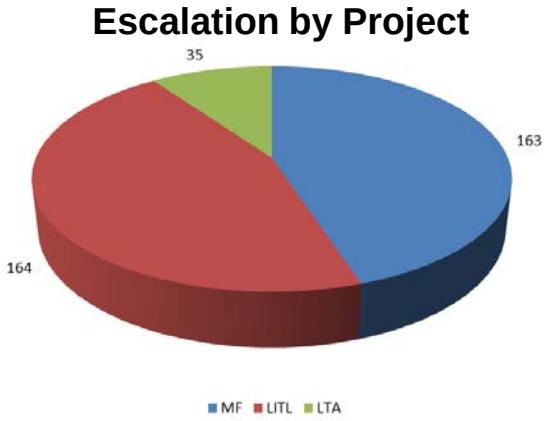
Tactical Risk Analysis Results (Westney)

Risk Analysis for the overall Lower Churchill Project suggests, at a P50 value, the project contingency would be $368 million ($5,833 million minus $5,465 million), which equates to 7% of the estimate.



Escalation Allowance





- $360 million in total escalation
- Custom project-specific model developed
- Used a combination of Global Insight, Power Advocate and LCP market intelligence
- Costs broken down into 30 bins
- Contract pricing provides greater certainty for some project components

DG2 Estimate Summary

LCP Phase 1 (Excluding Maritime Link)
DG2 Estimate Summary (millions Jan 2010 CDN $)

	MF	LTA	LITL	Totals
Base Estimate	$1,947.46	$290.95	$1,615.93	$3,854.34
Contingency	$284.33	$43.64	$236.12	$564.09
Escalation Allowance	$273.49	$61.35	$208.00	$542.84
Totals	$2,505.27	$395.94	$2,060.05	$4,961.27

% of Total	50.5%	8.0%	41.5%	100.0%

Questions

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