VALUE BY DESIGN – ALIGNING APPLICATION OF VALUE ENGINEERING WITH TRIPLE BOTTOM LINE

–Case Study from a Canadian Crown Corporation.

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VALUE BY DESIGN – ALIGNING APPLICATION OF VALUE ENGINEERING WITH TRIPLE BOTTOM LINE-

Presentation Outline

Value Engineering Sustainable development

- What is 'Triple Bottom Line'?
- BC Hydro & Sustainability
- Sustainable Appraisal of a Project
- "Value by Design" Practice
- Critical Success factors

Ruskin Case Study

- VE Experience @ Ruskin
- VE Process undertaken
- VE Proposals developed
- Selected Proposals
- Accomplishments &
- Lessons learned

BC Hydro is a Crown Corporation (a Government entity) Under B.C. Ministry of Energy, Mines and Petroleum Resources

BC Hydro's purpose:

to provide
reliable power
at low cost
for generations

- **Clean energy**
- **Low cost**
- **Sustainable Development**
- **Corporate Responsibility**

BC hydro

BC Hydro serves 94% of the Province's population of 4.4 million

30 hydropower plants
3 thermal plants

43000 to 54,000 GWh annually

Among the lowest electricity rates in North America
One of the greenest energy producers in the world

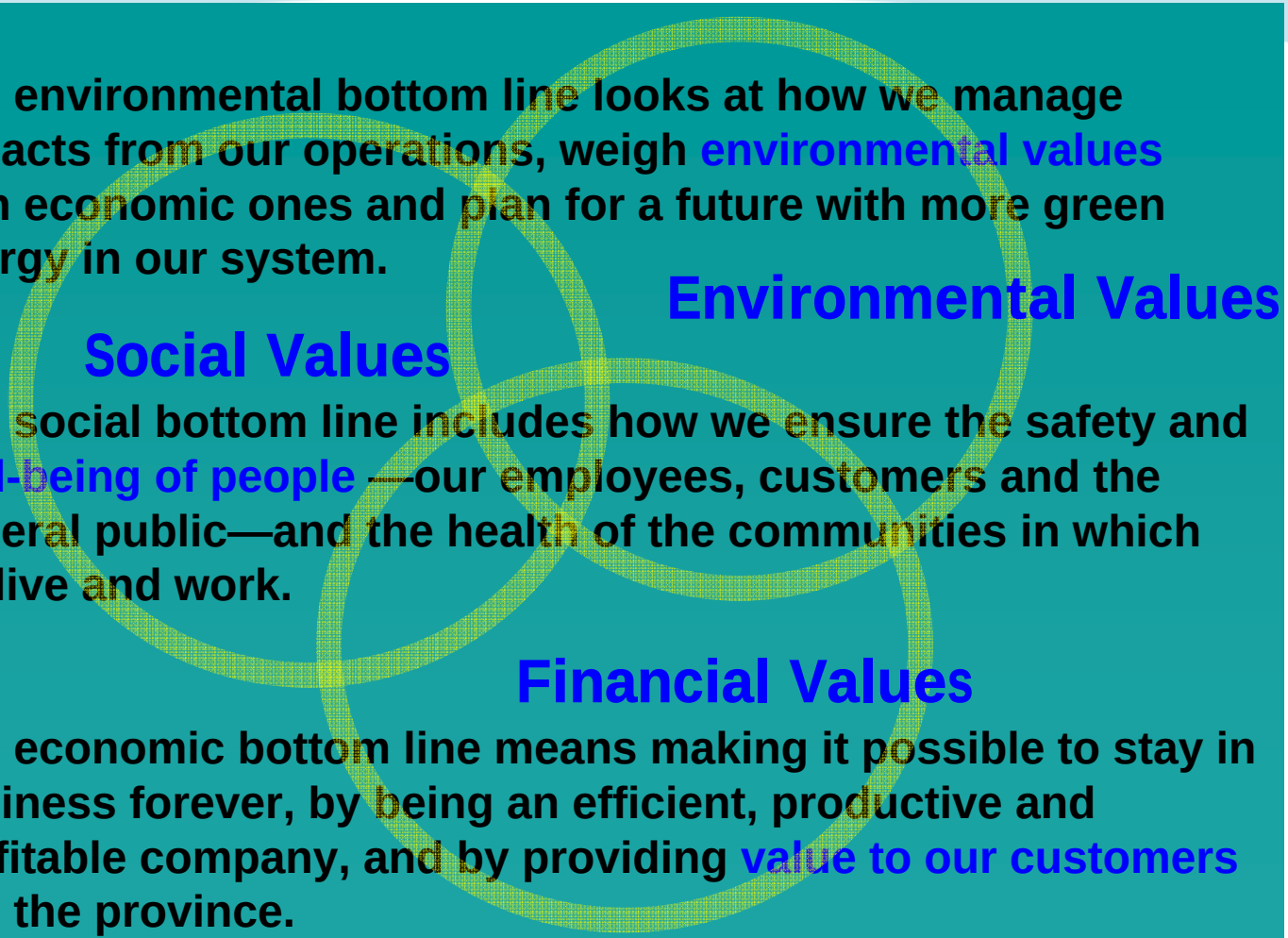
- **Clean energy**
- **Low cost**
- **Sustainable Development**
- **Corporate Responsibility**

Three Bottom Lines

BC Hydro is accountable to British Columbians to take care of the environment, meet community needs and deliver excellent financial results.

BC Hydro is committed to a path of sustainability whereby we balance, track and measure our performance along environmental, social and economic bottom lines

Three Bottom Lines



The environmental bottom line looks at how we manage impacts from our operations, weigh environmental values with economic ones and plan for a future with more green energy in our system.

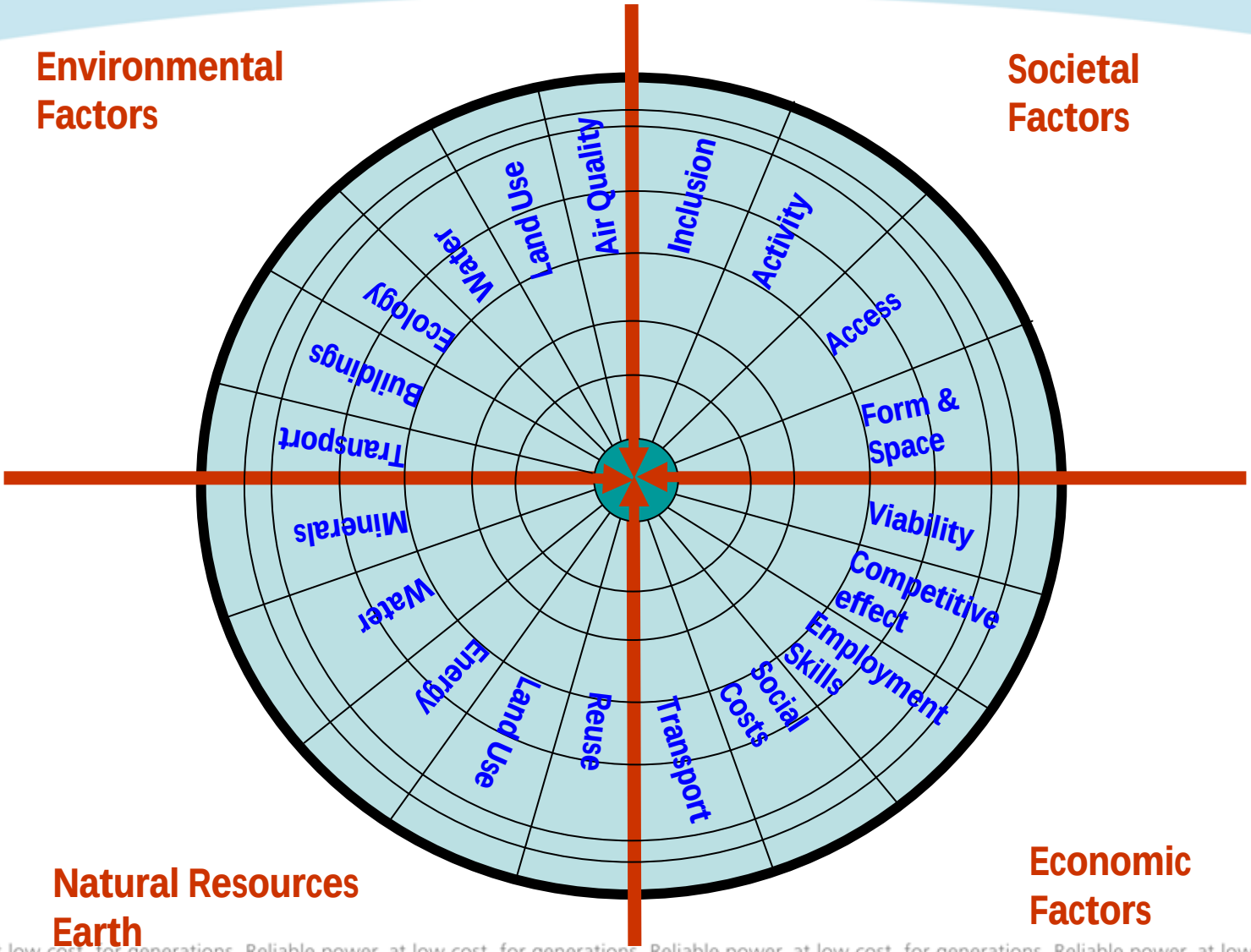
The social bottom line includes how we ensure the safety and well-being of people —our employees, customers and the general public—and the health of the communities in which we live and work.

The economic bottom line means making it possible to stay in business forever, by being an efficient, productive and profitable company, and by providing value to our customers and the province.

Reporting on the TBL is keeping BCH to remain the regional Sustainability leader

Our Department is EARG – Engineering Aboriginal Relations and Generation

Sustainable Appraisal of a Project



Reliable power, at low cost, for generations. Reliable power, at low cost, for generations. Reliable power, at low cost, for generations. Reliable power, at low cost, for generations.

SPeAR Riches, 2003

Motivation to do a VE Study at BC Hydro:

Possible alignment with TBL
Possible further leadership in sustainability of BC
Possible synergy with "Safety by Design" initiative

In house VE enthusiast took the ownership

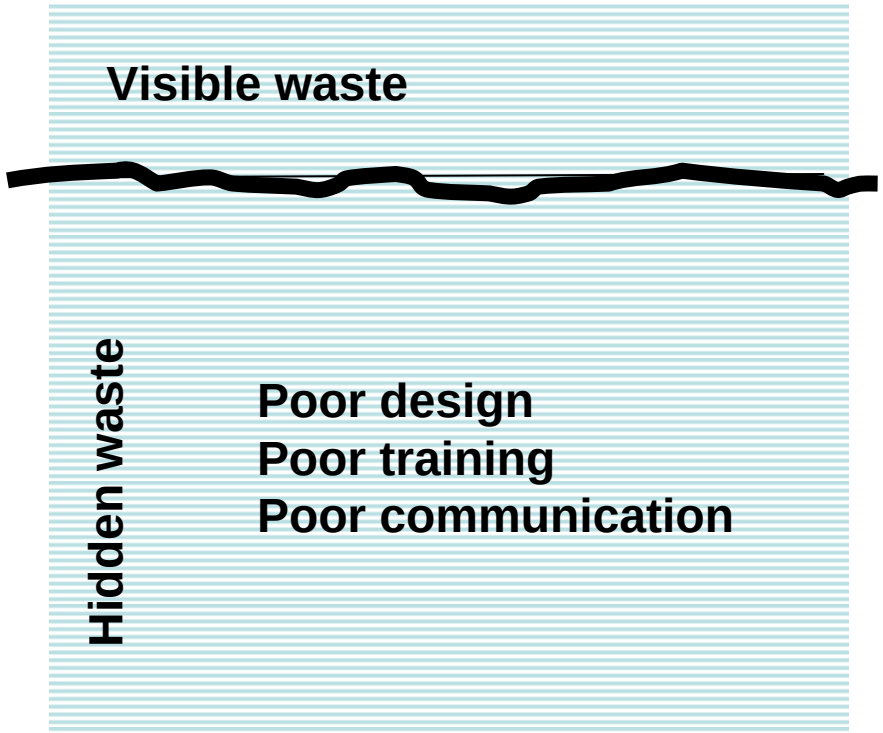
The Ruskin Dam upgrade project is part of the infrastructural renewal* that will enhance the safety and reliability of the system.

What are we doing to make our projects sustainable?

*** ~ $8 billion Capital work**

- ***Waste***
  - **Make it visible**
  - **Make it tangible**
  - **Seek / Identify opportunities to eliminate/modify**
    - **Small / large ideas, build on other's ideas..**

Unnecessary & secondary functions are like wastes that may be eliminated by creativity



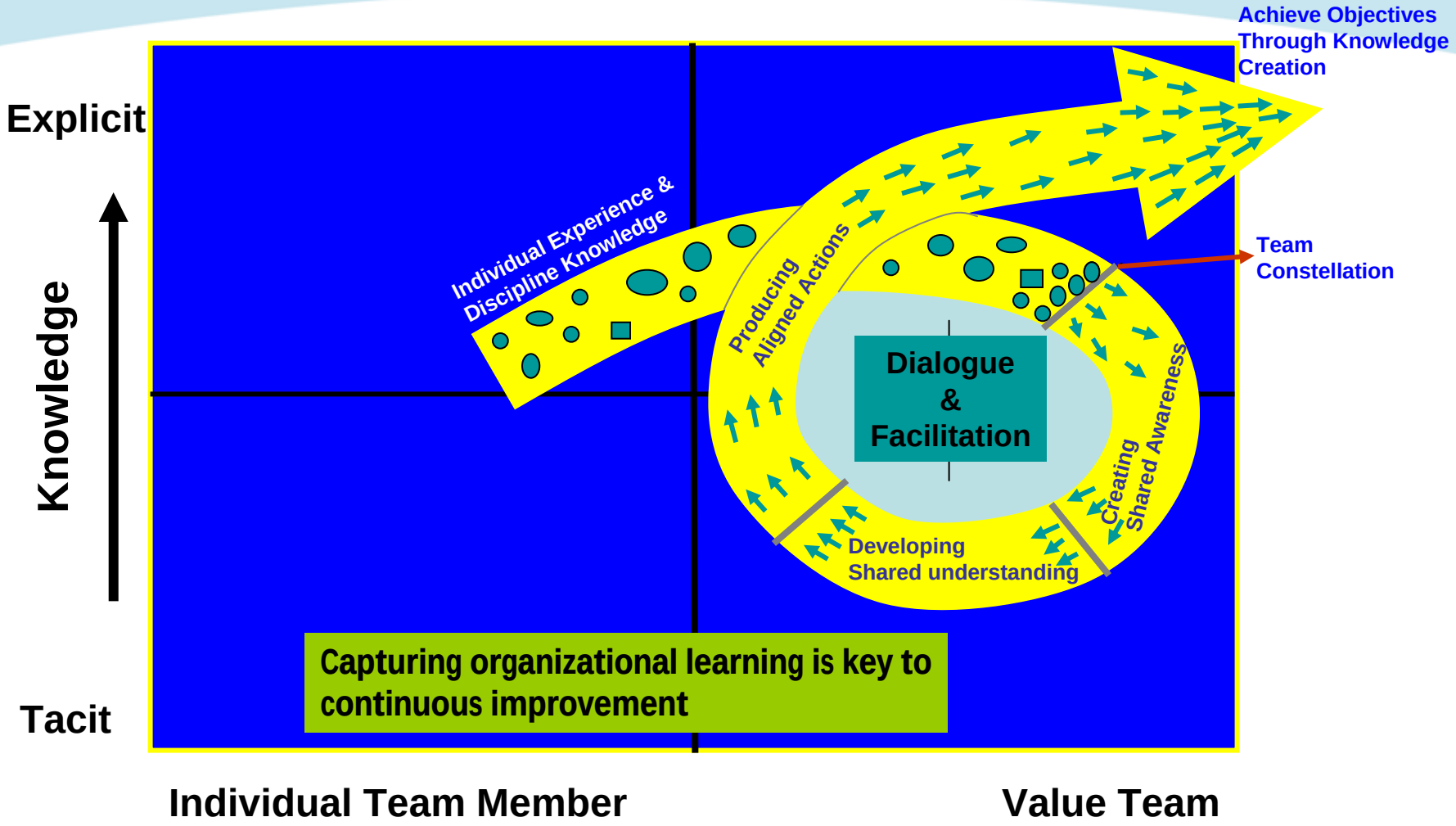
VALUE BY DESIGN*

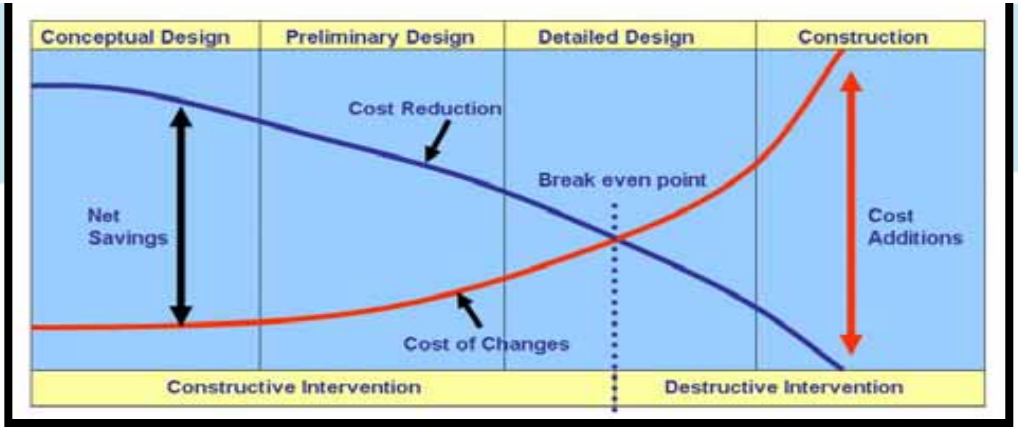
- an idea whose time has come

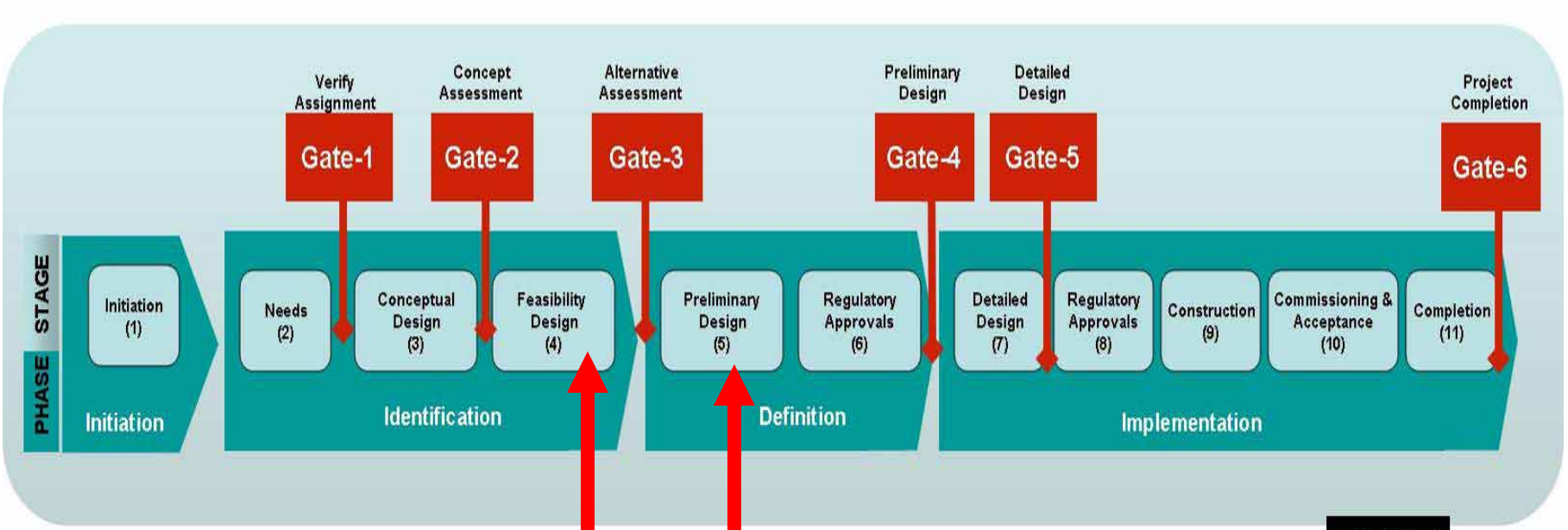
- **SYSTEMATIC APPROACH**
- **FULL / DELIBERATE USE OF CREATIVITY & TEAM WORK**
- **PRE DETERMINED CRITERIA FOR VALUE**
- **EVALUATION AND ASSESSMENT BY TEAM**
- **LIFE CYCLE – COST, MAINTENANCE, SUSTAINABILITY**
  - **FINANCIAL, ENVIRONMENTAL & SOCIAL (TBL)**
- **WORKS WELL WITH 'SAFETY BY DESIGN' STRATEGY**
- **KNOWLEDGE TRANSFER AND ORGANIZATIONAL LEARNING**
- **Use SDM to make final decisions on Proposals**

Value by Design –PMSP/PSDP Practice is being reviewed

Knowledge Creation Process in Value Team



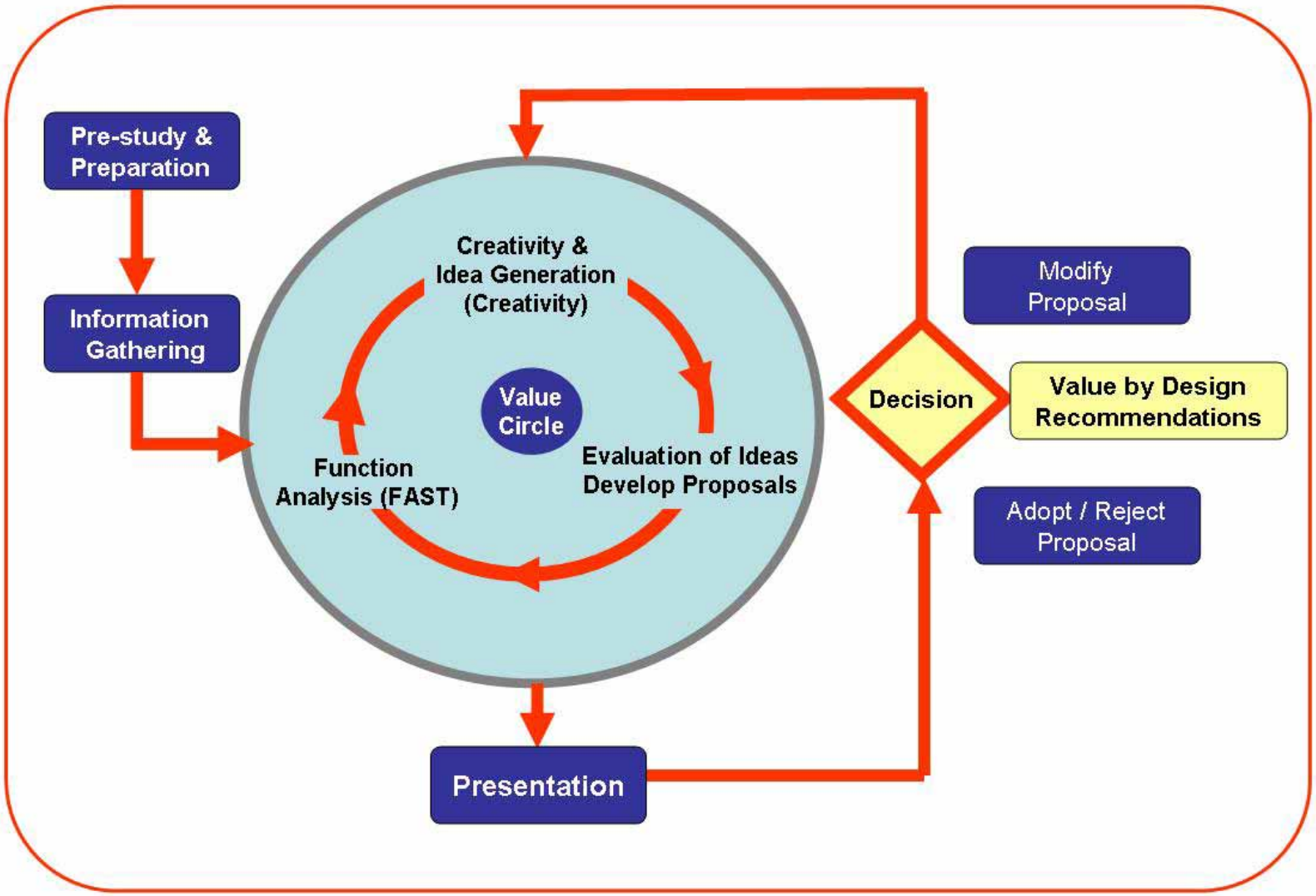




'Value by Design' Study

Follow-up & Review

Timing for Value Study in Project life cycle



Value by Design – Schematic Process Model

Value by Design - Responsibility Matrix.

	Task	Project Initiator	Project Manager	Project Engineer	Task Manger	Engineering Managers	Principal Engineer
1	Value by Design Study (Overall)	I	A	R	R	I	I
2	Sourcing a Certified Value Specialist		I	A	R		
3	Sourcing workshop participants		C	A	R	C	I
4	Ensuring participation of RESC	I	A	R	R		
5	Conducting Value Workshop	I	C	A	R	I	I
6	Value by Design Report	I	C	A	R	I	I
7	Presenting Recommendations	I	C	A	R	I	C
8	Review & Sign-off on Recommendations	I	A	R	R	R	R
9	Follow-up Review & Reporting for Gates 3 & 4	I	A	R	R	C	C
10	Summary & Lessons learned	I	C	A	R	I	I
A - Accountable; R- Responsible; C: Consulted; I: Informed							

Critical Success Factors

Methodology / Standard SAVE process; use a CVS

VE job plan must be followed systematically

Attitude of Participants

Right attitude, appropriate stakeholders, awareness of process

Executive support

VE workshops, sponsorship, implementation of results

Management of Process

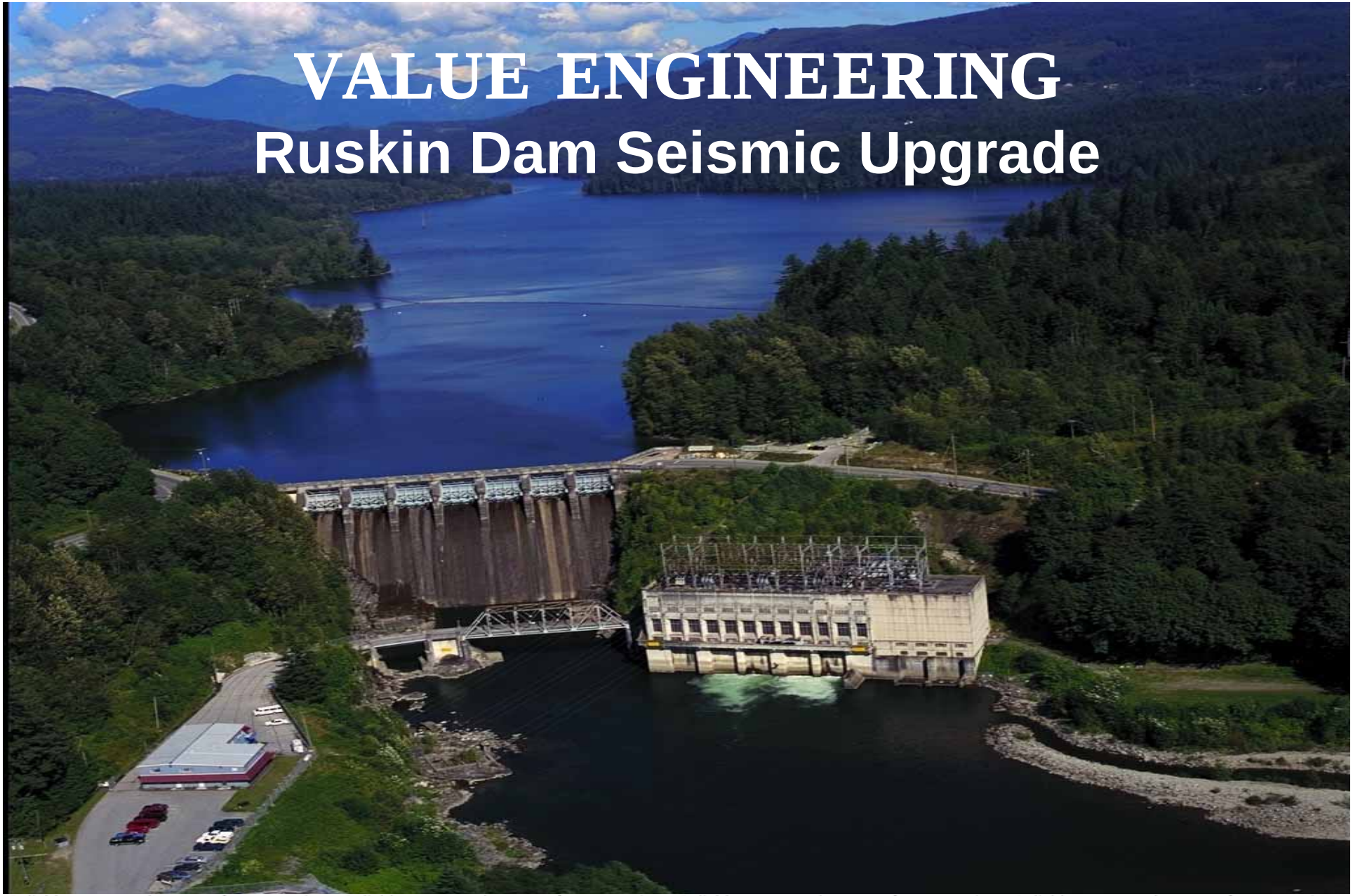
Clear objectives, timelines, follow-up actions, review and feedback

Professional Workshop Facilitation

Probing with right questions, using appropriate tools, managing the process, maintaining momentum of team, etc. etc.

VALUE ENGINEERING

Ruskin Dam Seismic Upgrade



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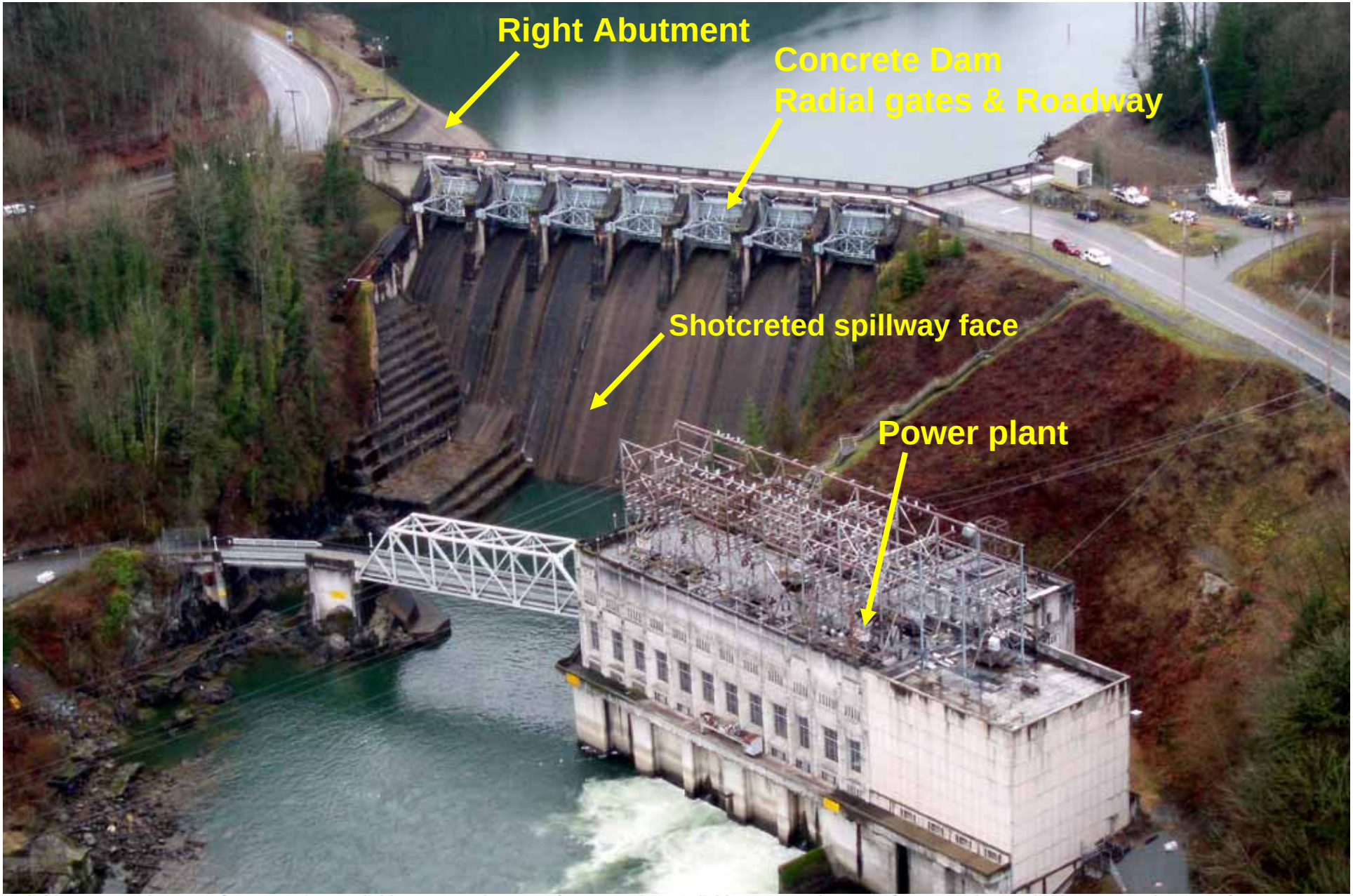

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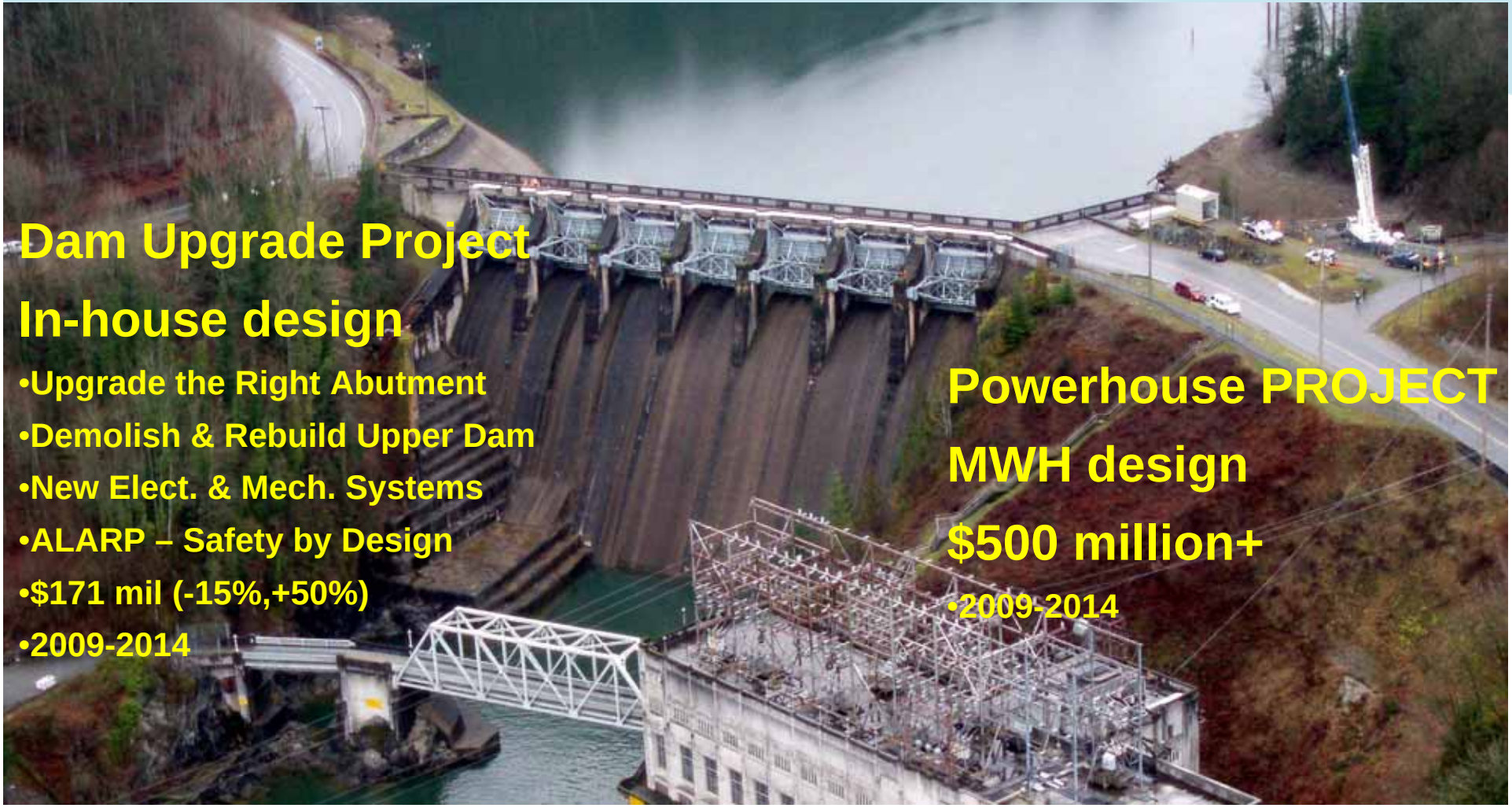
Ruskin Dam Seismic Upgrade

VALUE ENGINEERING

BC hydro



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EARG – Ruskin Dam Upgrade

VALUE ENGINEERING

BC hydro

VE Study Summary

- **Value Ideas:**
  - **176 'raw' Ideas Generated**
  - **60 Ideas Shortlisted**
  - **26 Ideas Developed in to VE Proposals**

Value Targets (functions)		
Ref. Function	**Functions**	**No. of Ideas Selected for proposals**
CF	Control Flow	8 Ideas
CS	Control Seepage	3 Ideas
EC	Estimate Correction	1 Idea
FC	Facilitate Construction	3 Ideas
MG	Maintain Gates	1 Idea
OG	Operate Gates	7 Ideas
PW	Protect Workers	1 Idea
SG	Support Gates	2 Ideas
Total VE proposals developed		**26 Ideas**

Summary of Proposals & Recommendations:

Rejected VE Proposals due to increased costs & not commensurate with benefits	2
VE Proposals considered for Design improvements (9 accepted)	12
Rejected VE Proposals after general considerations	7
Accepted VE Proposals for further consideration*	2
Accepted VE Proposals at the Preliminary Design*	3

Note: 1 proposal has been since modified and adopted

Accomplishments – Ruskin VE Study.

1. VE proposals resulted in significant design decisions with impact on cost estimate. **Cost savings of a minimum of $8 million achieved with a potential for additional savings**. $150,000 was spent for the study.

2. Several VE proposals adopted in design with no significant impact on cost, but **improved the quality of design**.

3. VE study resulted in **confirming that most of the design decisions thus far have been appropriate and thereby validating them**.

4. Established the **VE study as a tool for the management to ascertain that almost all possible design options have been studied** before making major design decisions.

5. Created **enhanced trust and reliance on the classic VE study** which will potentially be applied to all major projects in BC Hydro. This will hopefully result in a shift in culture of project delivery within the organization.

Ruskin Dam VE Study

Winner of Outstanding Accomplishment

2009 SAVE Annual Conference – Detroit 29 June to 2 July 2009

2009 Project Management Institute –Vancouver Chapter – Invited Lecture
2009 CSVA Conference Nov 23-24 Ottawa

Ruskin Dam Upgrade Project

The project is to upgrade the dam structure – upper concrete dam and the right abutment.

The Maximum Design Earthquake with an average Return Period of 10,000 years (7.5 on the Richter scale for that location)

Ruskin Dam VE Study is the first formal VE study in recent years within BC Hydro

Why seismic upgrade is important?

Key Objectives and WDB for Dam Upgrade Project

- **Address Dam Safety Issues**
  - Seepage and piping risk at right abutment
  - Seismic stability of right abutment
  - Seismic stability of concrete dam
- **Incorporate other User Requirements such as:**
  - Gate reliability
  - Physical security
  - Safety by Design principles

- Design Flood PMF: 3,650 m3/s
- Design Earthquake MDE: 0.71 g, M7.5

Purpose of the Ruskin VE Study *

Review and evaluate the methods and approaches specified in the feasibility design documents developed to-date.

Study the effectiveness of the proposed design solutions, including scheduling and phasing

Develop and/or refine concepts or components to improve performance and/or reduce cost, while maintaining design standards and codes, safety and reliability.

*** As per RFP to select a CVS**

Conceptual Design - key features:

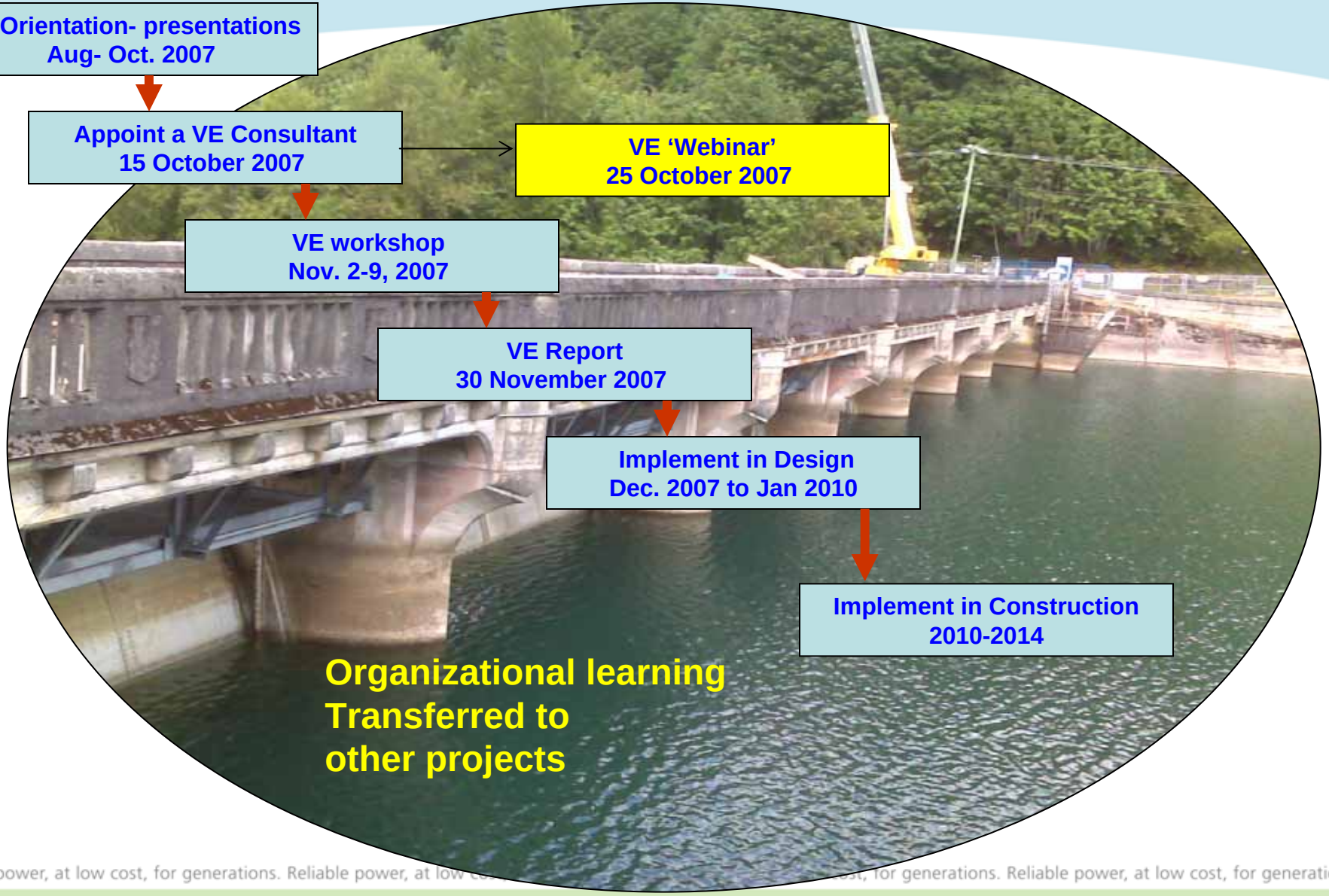
1. **Remediation work on the Right Abutment that provides a downstream reverse-filter blanket, installation of a jet grout cut off wall in the area of the downstream drainage adit, and strengthening of the soils beneath the upstream concrete slab by jet grouting**

2. **For the Upper Dam, the upgrade program involves demolition and replacement of the 6 existing concrete piers, 7 radial (steel) gates, and the bridge deck with new piers, 5 larger gates, and a wider roadway bridge**

3. **Construction of new electrical, mechanical and hydraulic operational systems, and corresponding control rooms to operate the gates.**

4. **The project is guided by principles of "Safety by Design" and the entire project is being designed accordingly.**

Ruskin Dam SEISMIC UPGRADE PROJECT
VALUE ENGINEERING STUDY



VE Phase	Agenda
Information Phase	•Webinar •Detailed Project Presentations •Defining Problem/Opportunities
Function Analysis	• Identifying Project Functions/FAST
Creativity	•Defining Targets •Creative Brainstorming
Evaluation	•Screening of Ideas to be Championed •Detailed Evaluation
Development	•Mid-Workshop Review Meeting with Owner/Agency •Technical Write-ups of VE Proposals
Presentation	• Team Presentation of VE Proposal

VE Workshop Agenda

Project:	Ruskin Dam Seismic Upgrade								Date:	November 2007
Function Analysis									**Sheet:**	1 of 2
Project Component	**Function**		**Classification**							
	Active Verb	**Measurable Noun**	**Goal**	**H/O**	**Basic**	**Supp.**	**Sec.**	**L/O**		
Project	Satisfy	Owner (BCH)	✓							
	Satisfy	Stakeholders		✓						
	Allocate	Space					✓			
	Design	Project						✓		
	Obtain	Regulator Approval	✓							
	Reduce	Seismic Risk			✓					
	Control	Seepage			✓					
	Extend	Service Life					✓			
	Ensure	Reliability					✓			
	Consult	First Nations				✓				
	Protect	Workers					✓			
	Protect	Public					✓			
	Protect	Environment				✓				
	Improve	Dam Safety		✓						
	Communicate	Status					✓			
	Maintain	Triple bottom line	✓							
Right Abutment	Control	Seepage			✓					
	Supports	Roadway					✓			
	Reduce	Seismic Risk			✓					
	Controls	Erosion					✓			
	Monitor	Performance					✓			
	Predict	Failure					✓			
Piers	Restrict	Flow					✓			
	Supports	Load					✓			
	Supports	Gates					✓			
	Supports	Stop Logs					✓			
	Supports	Roadway					✓			
	Supports	Machinery					✓			

Goal function
Higher Order Function
Basic Function
Supplementary function
Secondary function
Low Order function

Reliable power, at low cost, for generation ... ons.

Function Analysis - Excerpt

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Three major proposals with high impact

Following have been adopted and are currently being pursued with detailed assessment and cost estimation.

1. Install a plastic concrete cut off wall instead of jet grouting the right abutment slab
VE Proposal CS-10 –savings of $ 8.00 million – adopted additional environmental benefits.

2. Use parts of temp bulkhead to form perm. Bulkhead in lieu of stop logs
VE Proposal MG-16 – potential savings of $ 7.0 million

3. Maintain existing pier designs and use a design for the new gates so as to accommodate potential deformation of the skin plates.
VE Proposal SG-02 (modified)- design and cost impact is being studied for a hybrid idea. i.e., new gates with ductile behaviour

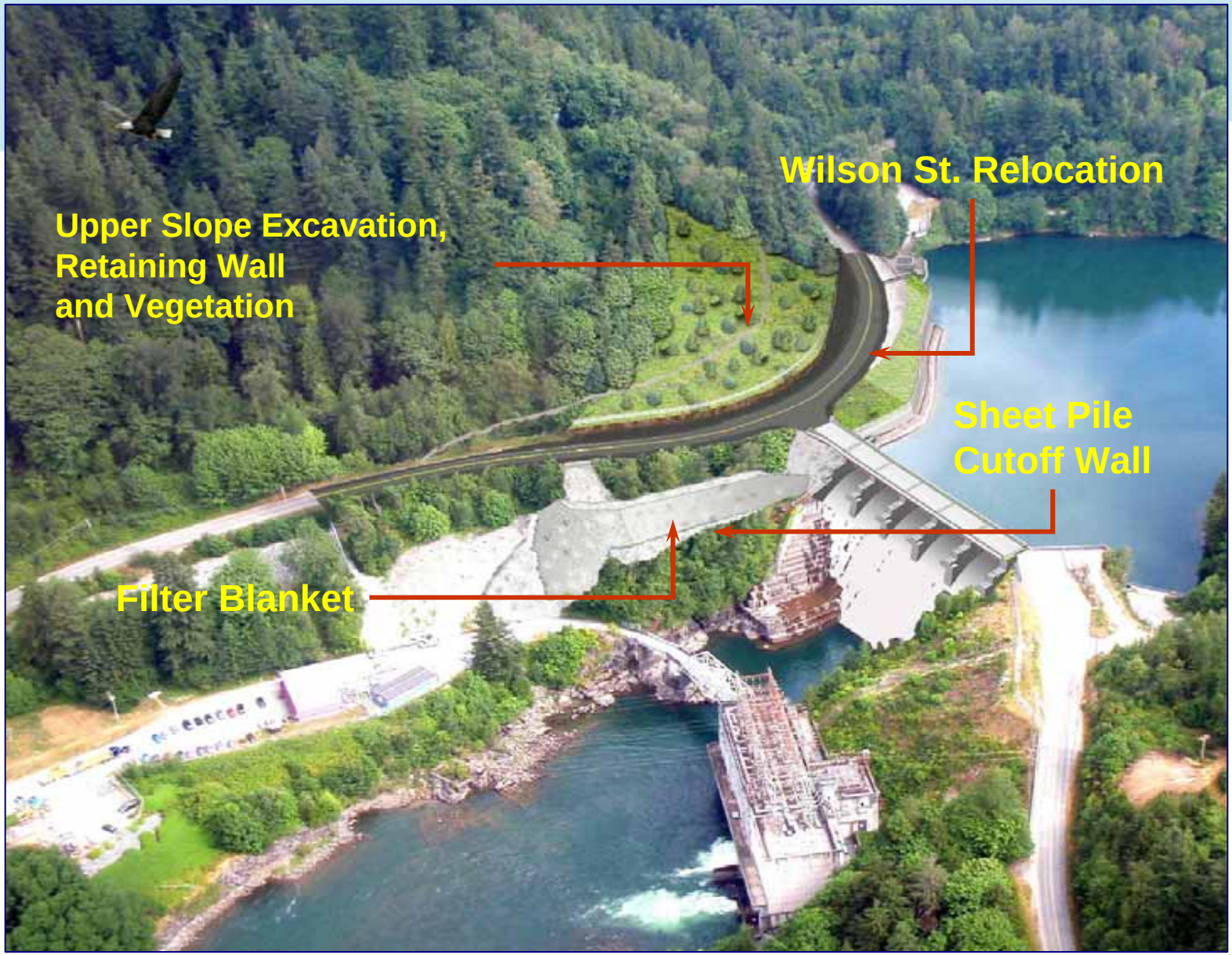
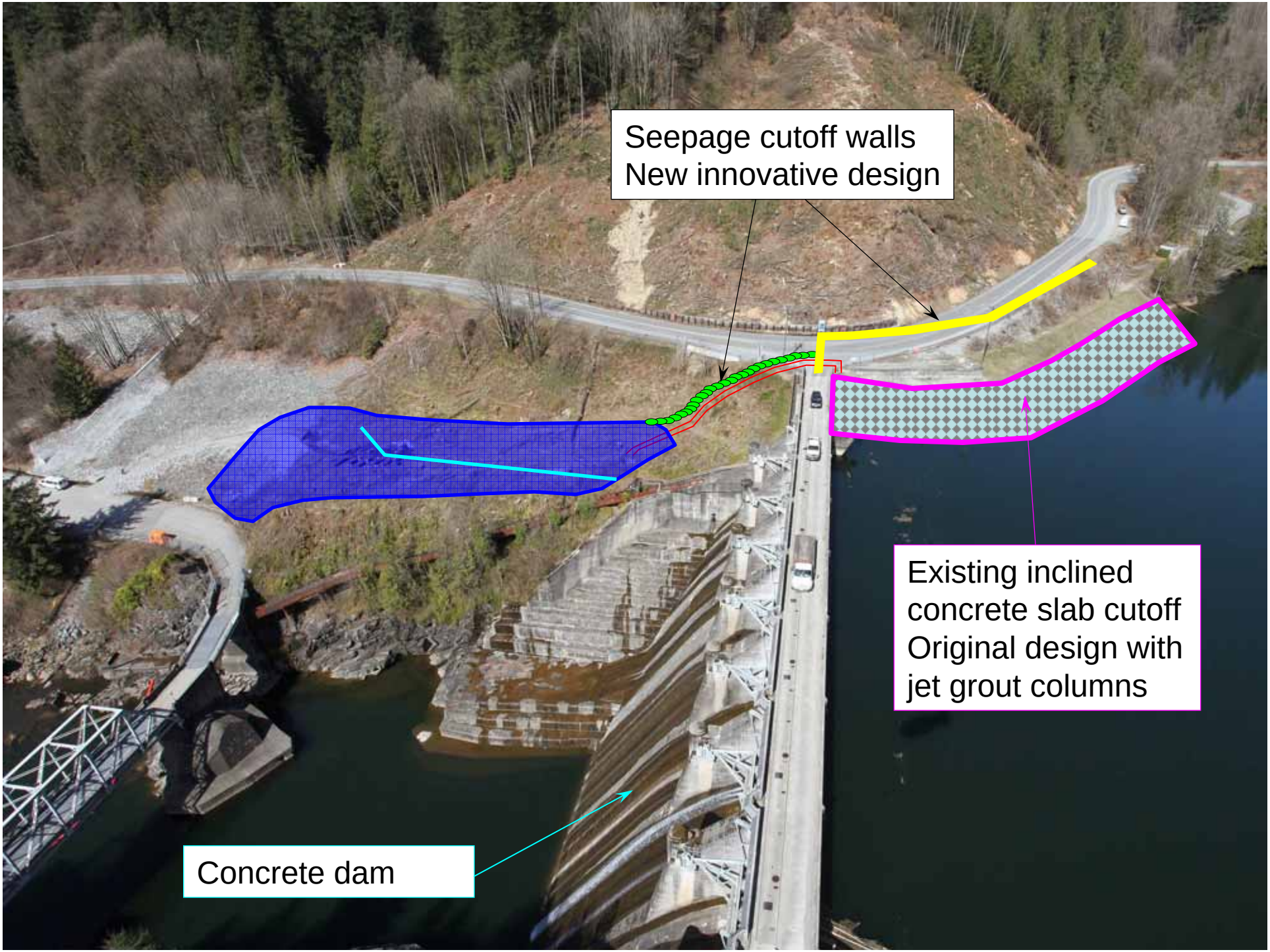
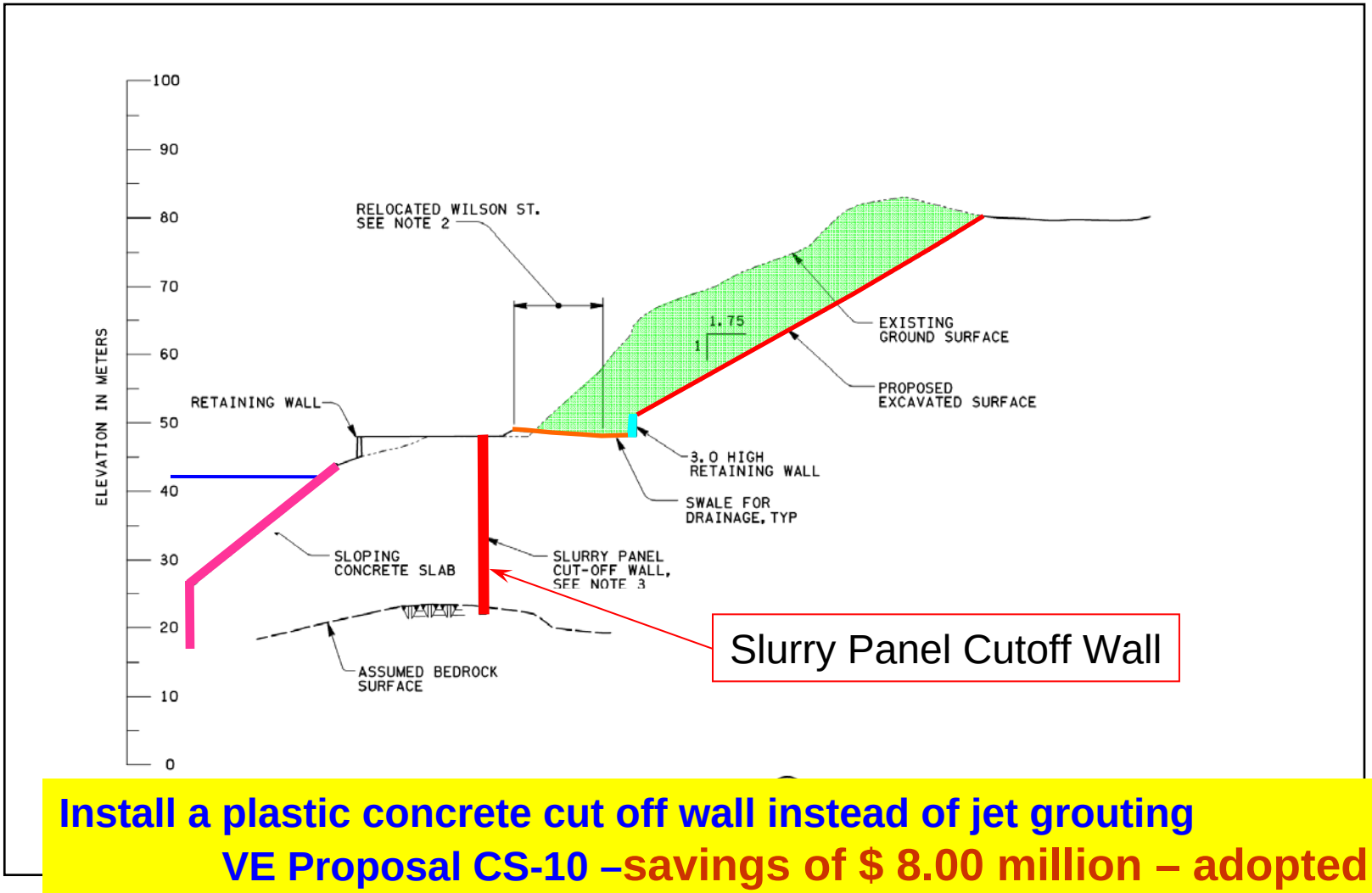


Photo Representation Of the Proposed work


Seepage cutoff walls
New innovative design
Existing inclined concrete slab cutoff
Original design with jet grout columns
Concrete dam

Cutoff Wall and Excavation



Install a plastic concrete cut off wall instead of jet grouting

VE Proposal CS-10 –savings of $ 8.00 million – adopted

additional environmental benefits not quantified.

Additional VE Proposals with high potential

Three proposals were chosen for further considerations in the detailed design phase when they will be evaluated for their merit. There were:

- **Construct the piers and gates system in structural steel**
  VE Proposal CF-17 - not being pursued as non traditional
  Potential savings of $35 million

- **Eliminate bulkhead and draw down the reservoir for construction**
  VE Proposal FC-01 – not viable for env. and other reasons
  Potential savings of #$8 million

- **Eliminate stop logs and draw down for maintenance.**
  VE Proposal MG-16 – may not be viable for environmental and other reasons
  Potential savings of $3 million

Design Suggestions / Improvements selected for further consideration

1.	Locate Electrical rooms in such a way that the seismic loads are less than 1.0g)	VE Proposal OG-01	Adopted
2.	Dampen the electrical room	VE Proposal OG-02	Discarded
3.	Use armoured cabling for all dam runs	VE Proposal OG-05	Adopted
4.	Automatic control of emergency generator	VE Proposal OG-11	Adopted
5.	Locate the circuit breakers inside electrical room, not on piers	VE Proposal OG-12	Adopted
6.	Provide hydraulic by-pass for oil for gate control system	VE Proposal OG-14	Adopted
7.	Minimize the hydraulic cylinder size	VE Proposal OG-18	Adopted
8.	Seismic dampening of gate skin plates	VE Proposal CF-11	Further study
9.	Use a self-balanced bulkhead with no support from piers	VE Proposal FC-10	Discarded
10.	Include a fuse-able bulkhead for emergency flood relief	VE Proposal FC-17	Discarded
11.	Provide access for slab inspection at right abutment	VE Proposal PW-12	Adopted
12.	Include the lost power revenue in calculations	VE Proposal EC-01	Adopted

The rejected major proposals were:

1.	Install a fuse gate in one bay with new pier configuration	VE Proposal CF-01 A
2.	Install 2 fuse gates with the old pier configuration	VE Proposal CF-01B
3.	Install 3 fuse gates in the exiting bays	VE Proposal CF-01C
4.	Use flap gates replacing all the 7 existing gates	VE Proposal CF-15
5.	Use radial gates on the sides and flap gates in the centre	VE Proposal CF-24
6.	Use strong back system to secure right abutment slabs	VE Proposal CS-29
7.	Distribute the loads from the centre piers to end piers by using bridge deck	VE Proposal SG-12

Accomplishments – Ruskin VE Study.

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5. Created **enhanced trust and reliance on the classic VE study** which will potentially be applied to all major projects in BC Hydro. This will hopefully result in a shift in culture of project delivery within the organization.

Lessons Learned

1. Gained valuable insight and an appreciation of the benefits of performing formal Value studies on major project initiatives.

2. VE study done at an earlier stage of the Ruskin Project would have been much more effective as more broader options could have been entertained in the creativity sessions.

3. Many of the design decisions had already been in place (sacred cows-don't touch) and it was too late to make major changes at the time of VE study.

4. During the workshop, many salient aspects beyond the scope of VE study emerged impacting the final product. They include the safety aspects, environmental issues, public consultation, etc.

5. Provided another opportunity to be due diligent in the design process

6. Several design improvements have been identified and adopted adding value to the project.

Lessons Learned contd.

7. Cost estimates developed in the VE workshop are only 'order of magnitude'

8. More design development and rigorous cost estimates are required to ascertain idea feasibility and acceptability.

9. Detailed follow-up study is required to meaningfully capture the impact of VE proposals.

10. Due diligence and detailed study are expected to take place after the VE proposals are developed at the workshop before accepting or rejecting them.

11. 'Safety by Design' - VE workshop gave ample insights into the safety aspects.

12. A Safety by Design workshop followed the VE study workshop and the team members observed that the VE study & SbD have many common themes.

Lessons Learned contd.

14. Management / Executive support is critical to success of a VE Study.

15. A champion to the cause of Value Engineering is critical to create an interest and sense of importance of the process amongst the team members.

16. The 'webinar' conducted for the study was well appreciated by all- saved time and was very effective.

17. For significant engineering projects, success of the Value Engineering study depends on the effectiveness of the facilitator and He/she must be a Value Engineering professional, a Certified Value Specialist.

18. By undertaking the VE study, the Corporation has saved a minimum of $8 million with a potential for additional savings. This represents a significant rate of return as the Value Engineering task cost had been only about $150,000.

VE study is in line with BC Hydro's Triple Bottom Line approach.

~ $8 billion worth of construction is on the books!

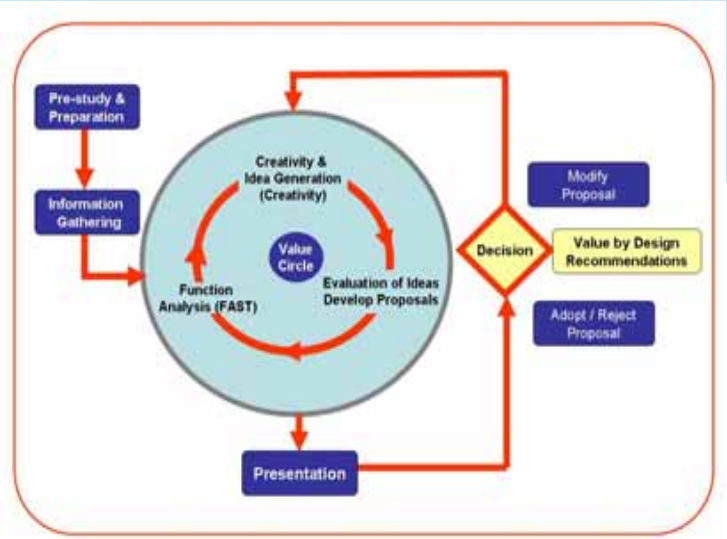
Value Engineering and Safety by Design share common principles.

Beware! Change may be on its way!

Value Engineering Study- a vehicle to bring triple bottom line and sustainability in practice.

- ***Significant revisions with cost impact***
- ***Cost neutral revisions.***
- ***Validation of design decisions***
- ***Management tool for due diligence***
- ***Cultural shift towards project delivery***

VALUE BY DESIGN !



- SYSTEMATIC APPROACH
- FULL USE OF CREATIVITY & TEAM WORK
- PRE DETERMINED CRITERIA FOR VALUE
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- LIFE CYCLE – COST, MAINTENANCE, SUSTAINABILITY
- WORKS WELL WITH SAFETY BY DESIGN STRATEGY
- KNOWLEDGE TRANSFER AND ORGANIZATIONAL LEARNING
- GOOD SYNERGY WITH SAFETY BY DESIGN
- TRIPLE BOTTOM LINE CONSIDERATIONS (NOT JUST $$)

Recap…

What is Triple Bottom Line?
BC Hydro & Sustainability

Value by Design ***- an idea whose time has come***

VE case study @ Ruskin
- **VE Process undertaken**
- **Accomplishments**
- **Lessons learned**

Knowledge transfer:
VE of John Hart Project initiated
17 Nov- Webinar; Dec 7-11 VE Workshop