

# **RALCO HYDROELECTRIC PROJECT CHILE**

## **Damage to upstream cofferdam**

- 1 RALCO HYDROELECTRIC POWER STATION CHILE**  
**Damage to upstream cofferdam**
- 2 API REFINERY ITALY**  
**Various losses**
- 3 SANFRANCISCO HYDROELECTRIC PROJECT ECUADOR**  
**Risk inspection - ALOP monitoring**

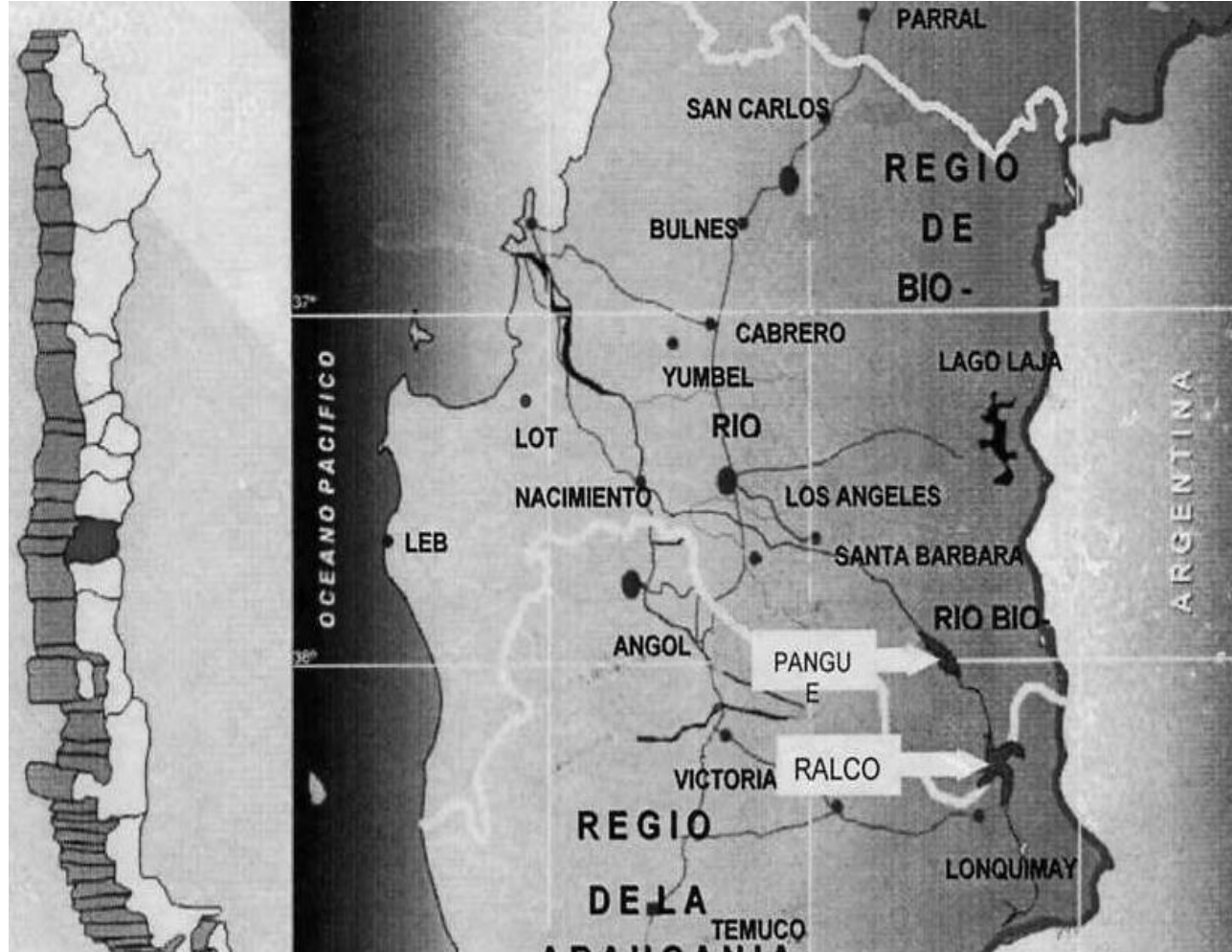
# RALCO HYDROELECTRIC PROJECT CHILE

## Damage to upstream cofferdam



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### LOCATION

- **Andes Mountains**
- **on 'Bio-Bio' river**
- **approximately 120 km south of Los Angeles.**
- **500 km south of Santiago**

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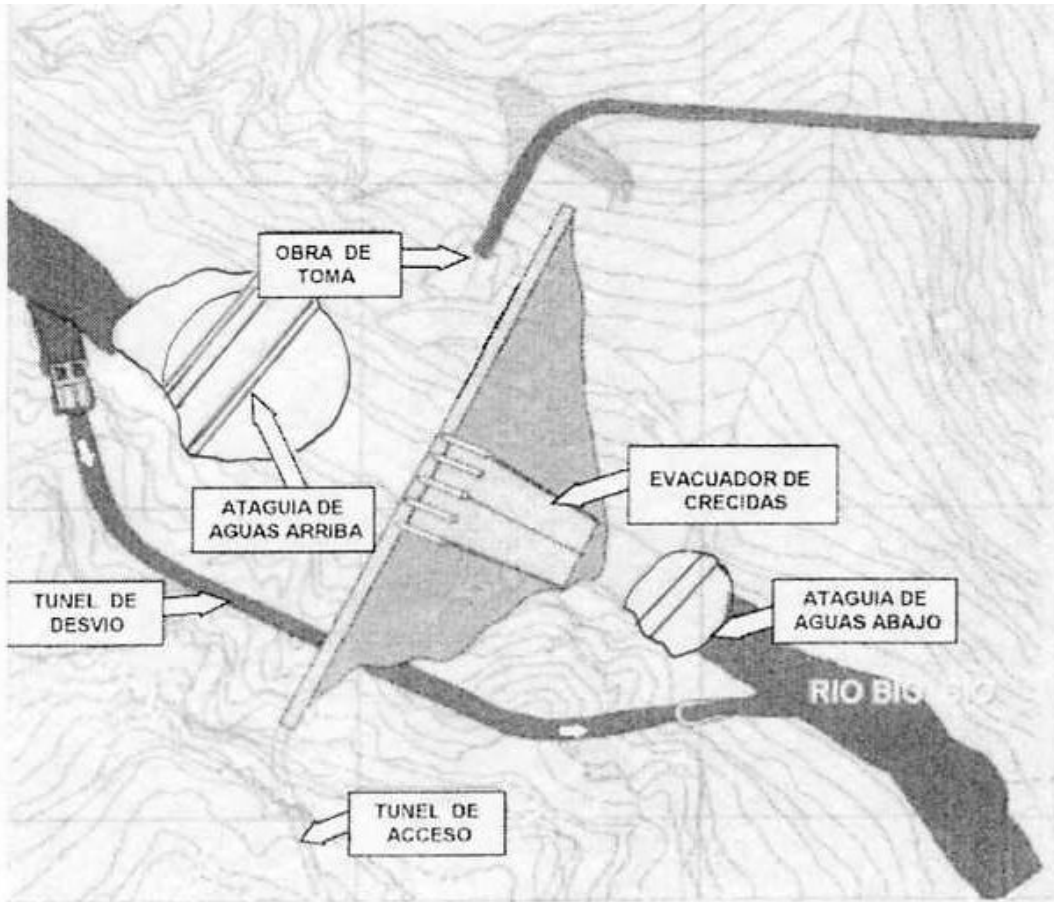


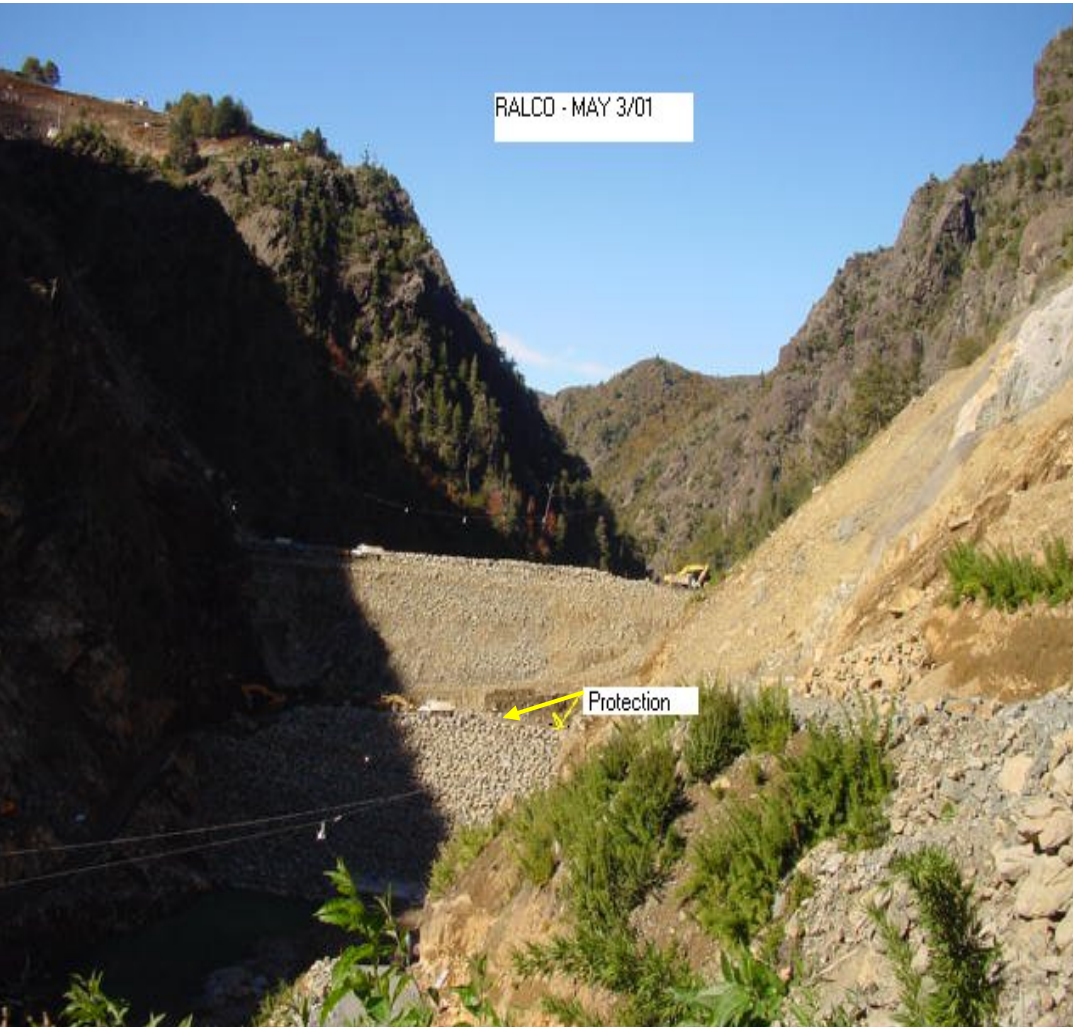
Figure No. 2  
Location of main works

### CHARACTERISTICS

- dam 155 m height
- crest length 350 m
- cavern works and generation units on left bank
- total capacity of 570 MW
- 13.5 m diameter diversion tunnel on right river bank
- Two cofferdams protect Main Dam construction area:
  - upstream 45 m high, crest height 635 m i.e
  - down stream height 605 m

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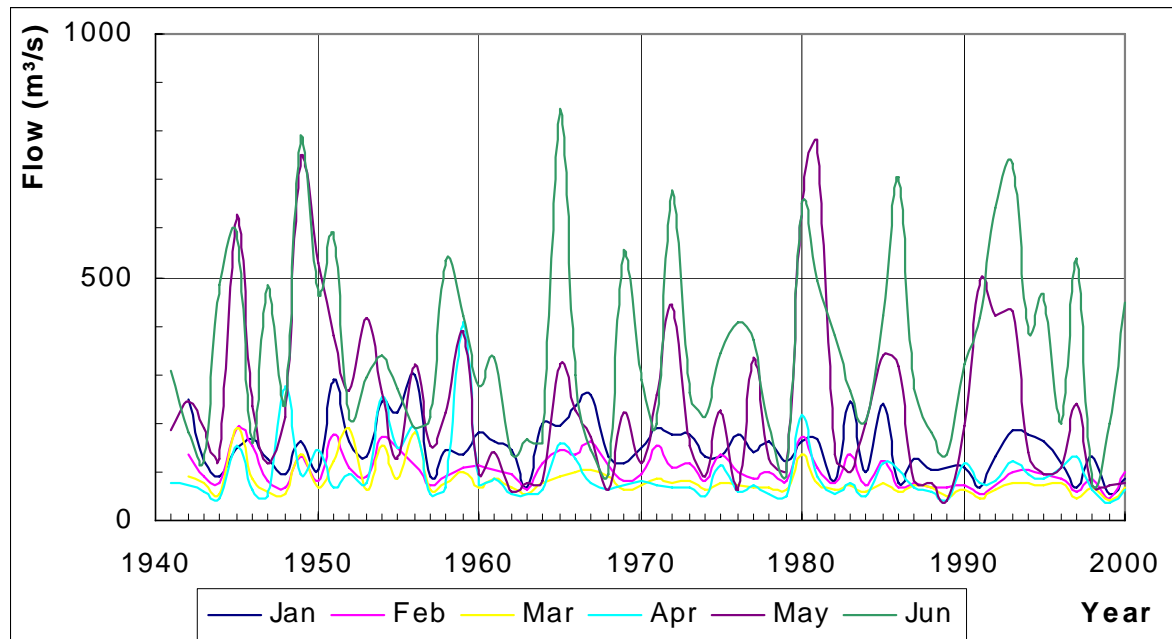


- The region in which the project is located is characterized by:
- High steep mountains with narrow valleys and gorges.
- Fast flowing streams and rivers.
- Construction site is located on the Bio-Bio River in a narrow valley surrounded by slopes partially covered with vegetation and sparse forests.

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## Damage to upstream cofferdam

- Local climate favourable to precipitation throughout year.
- Main rainfall registered since 1972 - seasonal and concentrated in autumn-winter period.
- Wet season from May to September construction programme/design must consider thaw period October to March increases Bio-Bio River flow.



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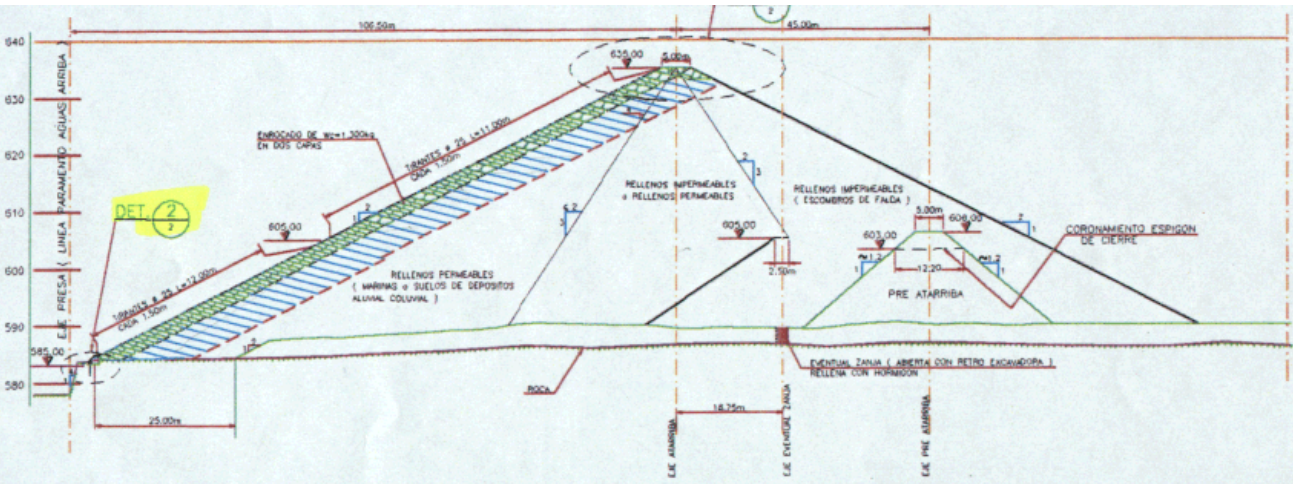
## Damage to upstream cofferdam

Project is dependent upon the successful integration of 3 significant components:

- Design
- Work method
- Construction Program

# RALCO HYDROELECTRIC PROJECT CHILE

## Damage to upstream cofferdam



- 27th May 2001:
- crest level 635 m except 10 m x 2 m access way
- Rock protection level 628 m
- Other work, included but not limited to:
  - Anchoring of the rock protection mesh to abutments
  - Completion of crest at access way
  - Preparation and protection works of crest and downstream abutments



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## Damage to upstream cofferdam



### COFFERDAM OVERTOPPED:

- 22:30 h on 27th  
May 2001
- FAILURE  
OCCURRED  
SHORTLY  
AFTERWARDS

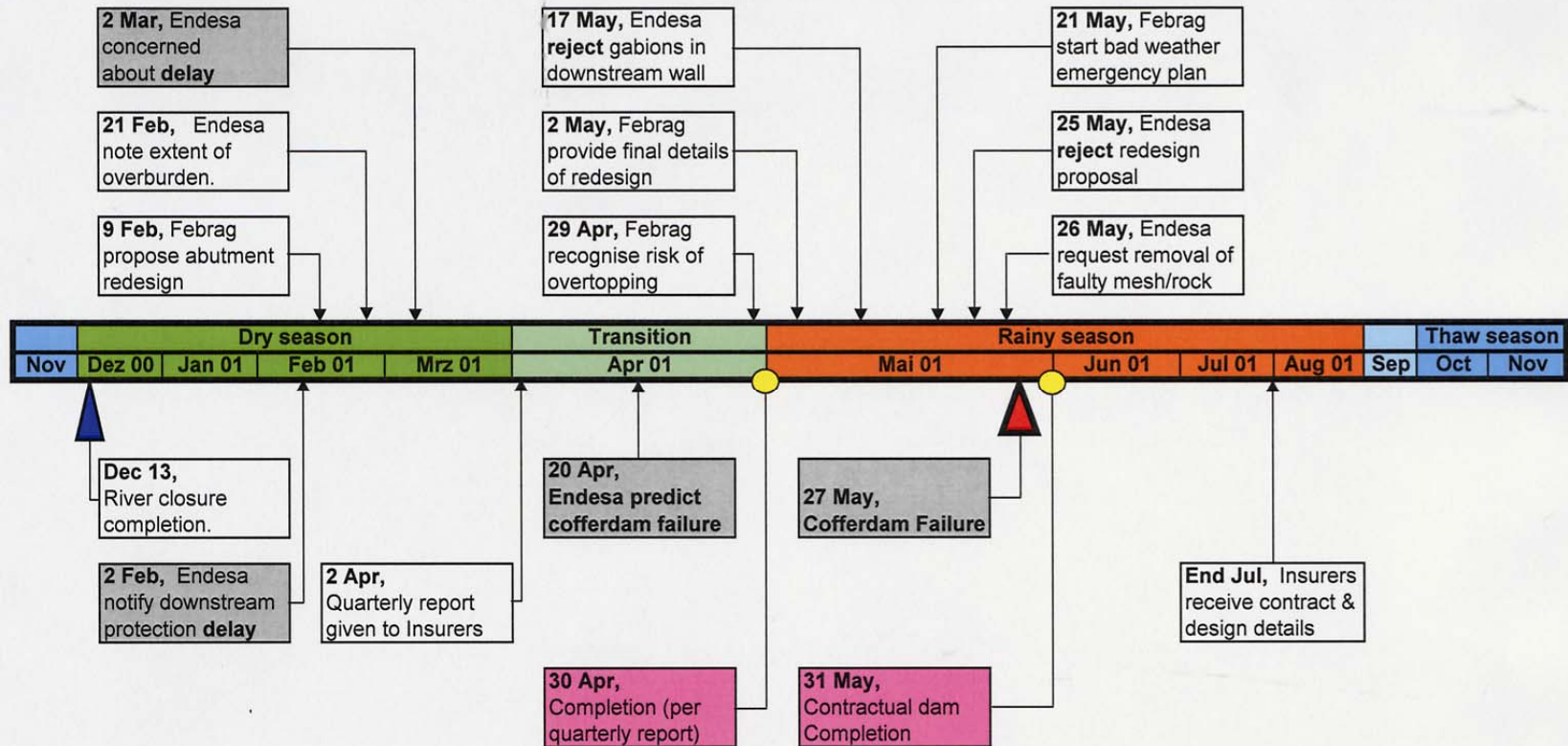
# RALCO HYDROELECTRIC PROJECT CHILE

## Damage to upstream cofferdam

### ● LG DAM DESIGN AND FAILURE MECHANISM

# RALCO HYDROELECTRIC PROJECT CHILE

## Damage to upstream cofferdam



TIMELINE OF CRITICAL EVENTS AND SIGNIFICANT CORRESPONDENCE BETWEEN RIVER CLOSURE AND DATE OF LOSS.

# RALCO HYDROELECTRIC PROJECT CHILE

## Damage to upstream cofferdam

### POLICY LIABILITY

- **Insurance policy comprises:**
  - **Section 1: Construction and Erection All Risks**
  - **Section 2: Third Party Liability**
  - **Section 3: Advanced Loss of Profits**

# RALCO HYDROELECTRIC PROJECT CHILE

## Damage to upstream cofferdam

### CLAIM

- DAMAGE TO WORKS UNDER POLICY SECTION 1: **US\$ 30.000.000,00**
- RESULTING ALOP UNDER POLICY SECTION 3: **US\$ 60.000.000,00**

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## Damage to upstream cofferdam

### OPERATIVE CLAUSE

- *“This insurance covers, following that mentioned in the descriptive section, material damage suffered by the insured property by any cause not expressly excluded and which could not be covered by the additional covers as given under Clause 2.”*

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## Damage to upstream cofferdam

### CAUSE:

- **EROSION OF THE COLLUVIAL MATERIAL ON THE LEFT BANK ABUTMENT**

- **DESIGN EXCLUSION – DE 5**

*This Policy excludes the costs necessary to replace, repair or rectify any defect in design, drawings specifications, materials, or workmanship, however in the event that unforeseen damage results from this defect, this exclusion is limited to the additional costs incurred to improve the original design, specifications or drawings.*

- **DE 5 EXCLUSION - NOT APPLICABLE TO LOSS**

**Loss did not occur due to ‘faulty design’ - Loss occurred due to an increase in river volume which was considering that the construction had been extended in to the wet season, was to a large extent foreseeable.**

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## Damage to upstream cofferdam

**SAFE COMPLETION OF PROJECT DEPENDED UPON  
SUCCESSFUL INTEGRATION OF 3 COMPONENTS:**

- **DESIGN**
- **WORK METHOD**
- **CONSTRUCTION PROGRAM**



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## **Damage to upstream cofferdam**

### **PRINCIPAL CONTRIBUTING CAUSES OF UPSTREAM COFFERDAM FAILURE:**

- **acceptance to build the cofferdam in wet season**
- **critical delays in initial stages of the project**
- **non-compliance with crucial provisions regarding work method, construction program and safety works, as stipulated in contract conditions**

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### SUMMARISED ASSESSMENT OF COVER

- *Clause 9* Insured must provide all details and information for Insurers to fully appreciate and understand the risk.
- *Condition 'K'* Complements Clause 9 requires Insured to provide accurate quarterly reports confirming construction progress.
- **INSURED DID NOT PROVIDE INSURERS WITH THE REQUIRED INFORMATION TO FOLLOW THE COFFERDAM CONSTRUCTION.**
- **ACTUAL RISKS INVOLVED MISREPRESENTED.**
- **COMPLETION DATE OF COFFERDAM AGREED WITH CONTRACTOR DIFFERED TO THAT AGREED WITH INSURERS.**
- **DEVIATION FROM CONSTRUCTION PROGRAM/CHANGES TO DESIGN/WORK METHOD CONSTITUTE DIFFERENT RISK TO THAT ACCEPTED BY INSURERS.**

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### OPTIONS AVAILABLE TO INSURERS IF NOTIFIED OF CHANGE IN RISK:

- enter into discussions with Insured to agree mutually acceptable means of continuing construction.
- continue cover with an increased premium for increased risk.
- continue cover, excluding damage resulting from overtopping during construction caused by change in design.
- continue cover, excluding damage resulting from overtopping after 30th of April 2001.
- suspend cover until originally accepted risk had been reinstated.

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- **ENDORSEMENT 110** (special condition relative to protection measures in event of flood)
- **ITEM C OF 'CONDITIONS'** (relative to cover for flood and inundation)
- **Cover for losses related to rainfall/flood subject to:  
Insured taking adequate protection measures compatible with international engineering standards**
- **Note:**  
**Endorsement only invoked if there is flagrant and repeated non compliance with these protection measures.**

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## Damage to upstream cofferdam

### CONCLUSION

- Insured failed to implement measures in accordance with international practice despite repeated warnings and protests by Principal
- Acceptance of the cofferdam completion date transferred from dry to wet season:
- Significant deviation from construction programme, design (unknown to Insurers)
- Non-completion of protection measures.
- Site log book entries since early stage of project confirm both Principal and Contractor aware of catastrophic consequences for works in case of increased river flow.
- Apart from breaches of endorsement '110' and item 'C' of the Conditions, loss cannot be considered as being accidental, unexpected, unforeseen.
- **Circumstances and nature of this loss does not constitute insured event.**