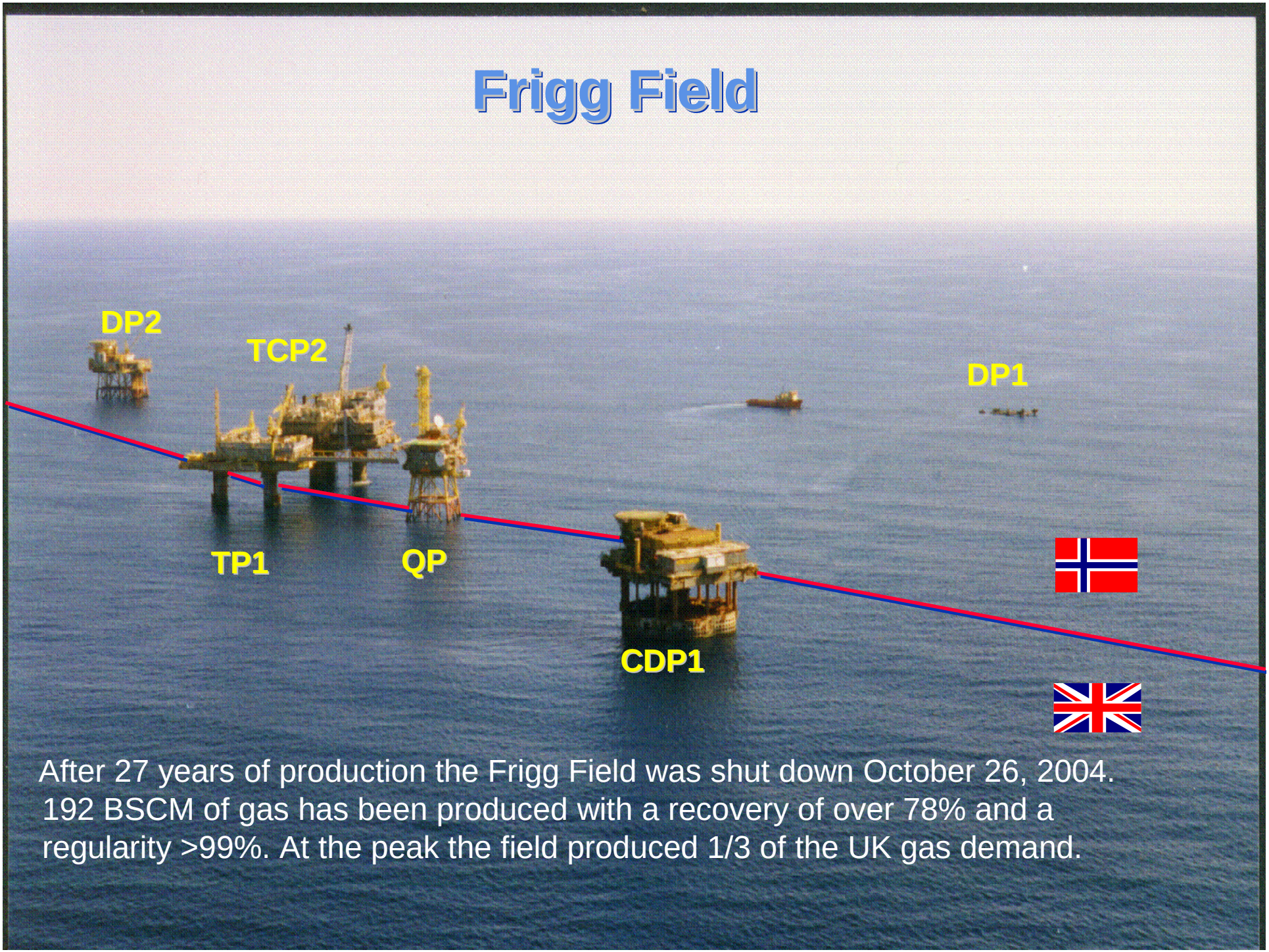
TOTAL E&P NORGE AS

From a Chinese butterfly to nails

WGC 2006 – 06.06.2006
Christian Hansen

TOTAL

Frigg Field



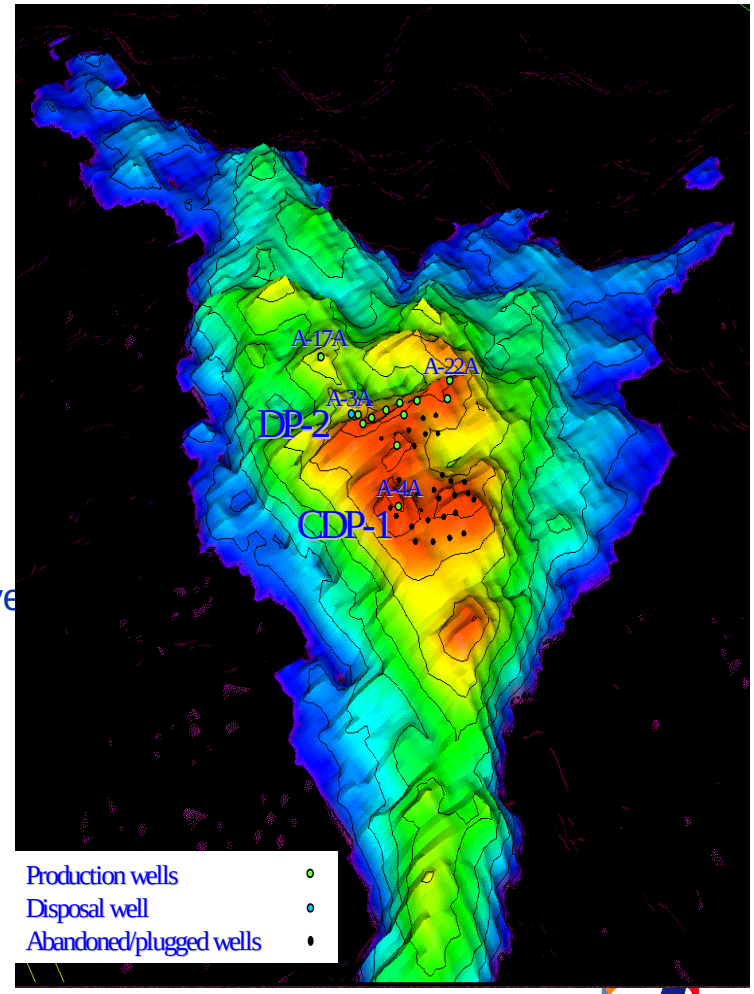
After 27 years of production the Frigg Field was shut down October 26, 2004. 192 BSCM of gas has been produced with a recovery of over 78% and a regularity >99%. At the peak the field produced 1/3 of the UK gas demand.

Field reservoir

- Discovered 1971 – Production SU 1977
- Field coverage 100 km^2, 160m gas column, 8-9 m oil rim

- Formation: Frigg sands, Eocene
- Reservoir depth: 1900 msl
- Average reservoir thickness: 160m
- Initial reservoir pressure: 190 b (hydrostatic)
- Reservoir temperature: 60 degC
- GOR: 200 000
- Average porosity: 25-30%
- Reservoir permeability: 1-3 D
- Number producers drilled: 47
- Production mechanisms: Natural depletion with strong aquifer drive

- Estimated GOIP 247 10^9 Sm^3
- Total production raw gas: 192 10^9 Sm^3 (recovery factor 78 %)
- Condensate content: 4,3 g/ Sm^3
- C1: 95.5 - Gas specific gravity: 0.7



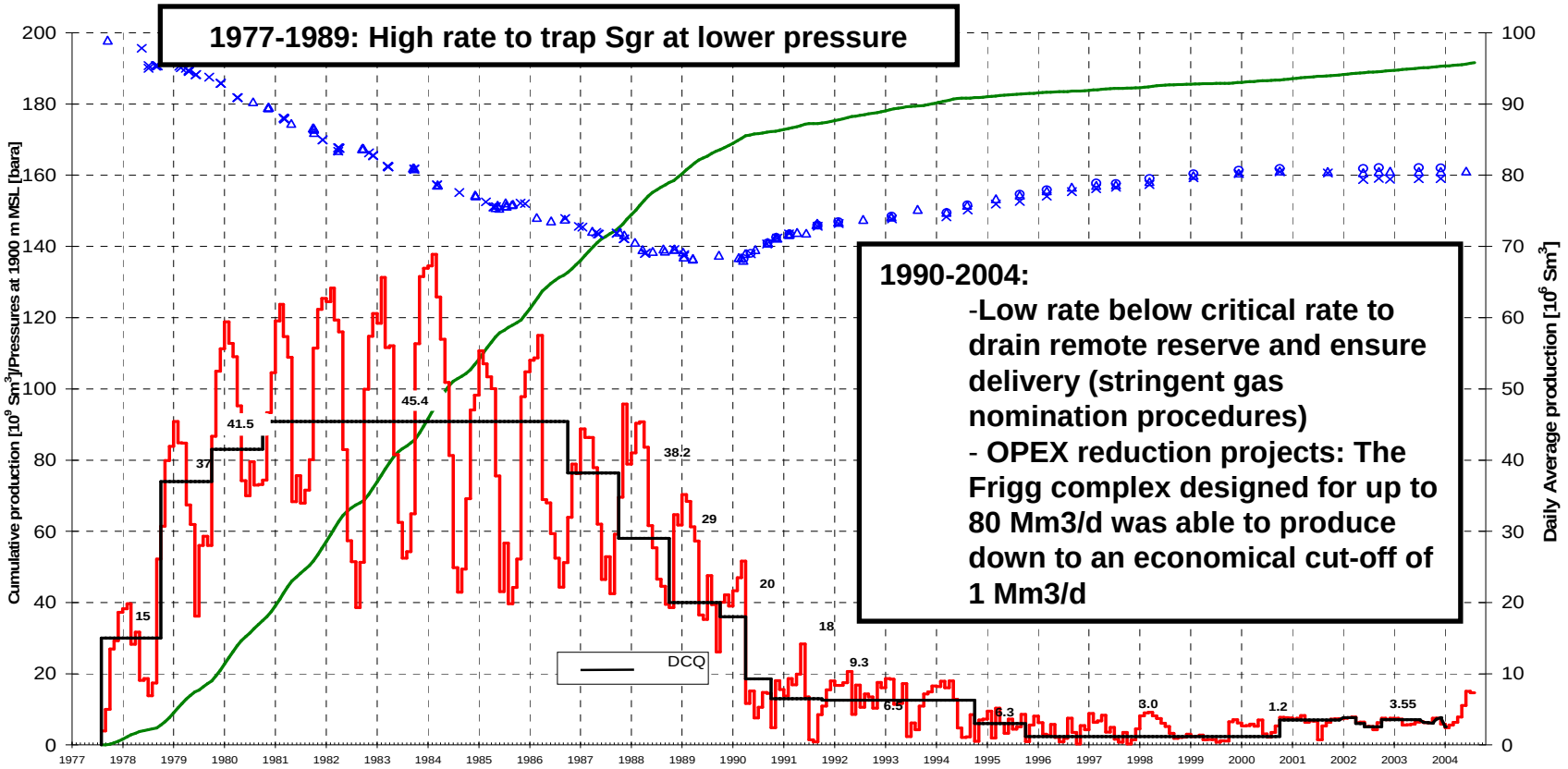
TOTAL

Frigg - Facts

- 2 Drilling platforms
- 2 Process/Compression platforms
- 1 Living Quarter/Control platform
- Capacity 80 MSm^3/day
- 24 X 2 Wells
- 3 Compressors à 40 MSm^3/day

Actions: Production strategy

- Production strategy with two periods for optimal recovery



TOTAL

Safety – Competence and/or culture?

- No gas leaks on Frigg the last 6 years of production!
- Culture is important, but changes with time and society – a moving target!
- Competence should be your backbone!
- Teach your managers to be credible!

Cost Savings

Opex Reduction Projects on Frigg:

Target : 30% reduction from 1993 to 1998

Opex 1993: 73 M€

Opex 1998: 46 M€

Achieved 37% reduction

2004 OPEX: 44 M€

TOTAL

OPEX reduction to maintain profitability

- **RED-OPEX Plan (1993-95): 36 target minded improvement projects of which 28 came in with savings of a total of 12 M€/Y (80 persons involved):**
- **Demanning of Drilling platform (remotely controlled)**
- **Elimination of Marine Structure Dept.**
- **New modification handling process/organisation**
- **Optimised use/sharing of supply boats/helicopters**
- **Work-unit analysis (organisational entities)**
- **Introduction of semi professionel emergency organisations**
- **New inspection strategy**
- **etc.**

All in all resulting in reorganisations/demanning and more efficient work processes

TOTAL

Not sufficient OPEX reductions, which brought us to the FUTOP Project:

FUTOP (Future Operations) (1996-97) Project:

Performed as an in-depth total concept project by own personnel including in-house development of:

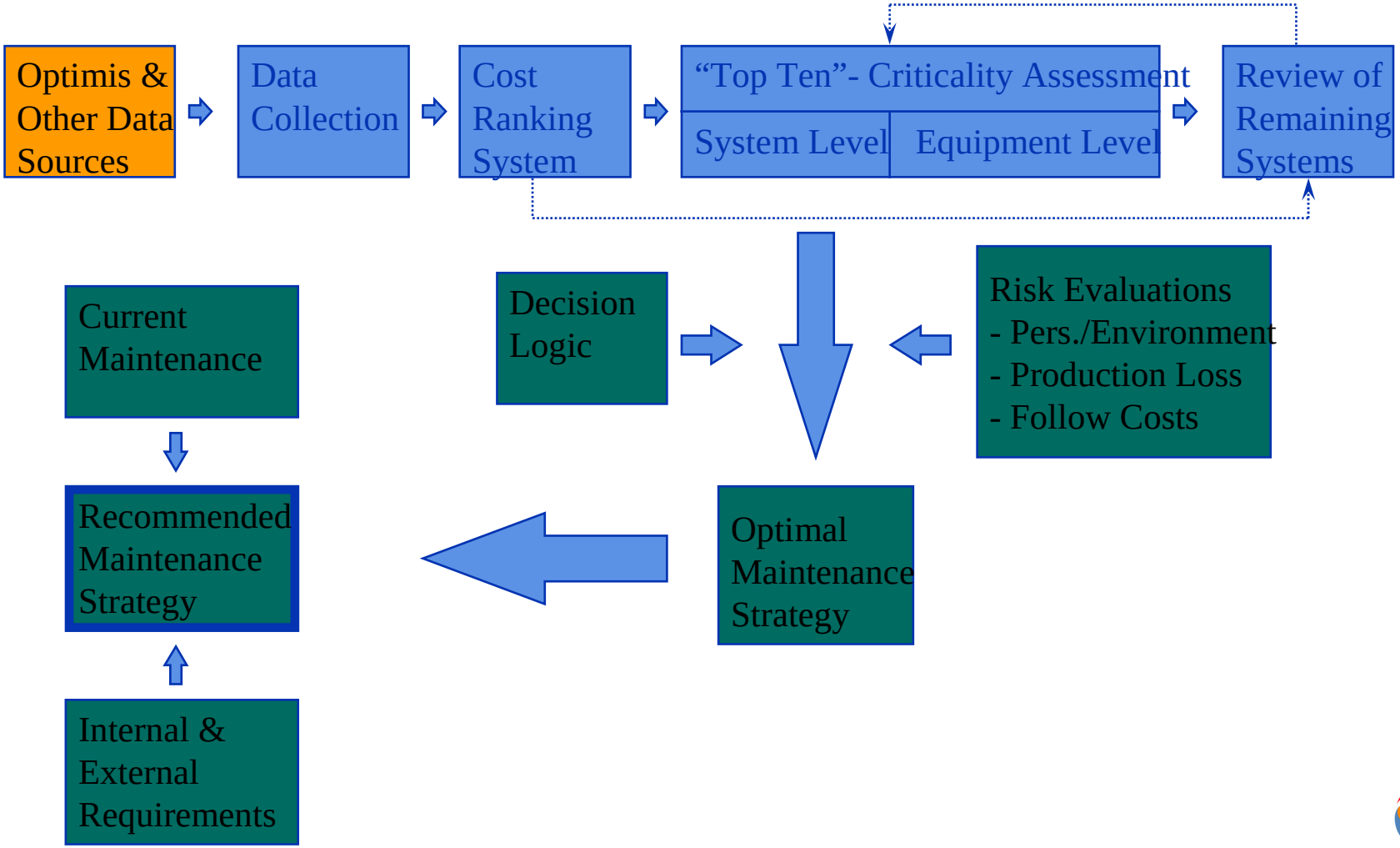
- **Cost models**
- **New maintenance philosophy**
- **Technical reliability, availability, maintainabilty (RAM) models**
- **New optimised Production philosophy**
- **New organisational models**

and with the objectives to:

- **Develop an optimum operational and organisational philosophy giving the lowest possible OPEX to maximise the economical lifetime of Frigg and Heimdal.**
- **Make all the necessary preparations for the implementation of the new philosophy and corresponding organisation.**
- **Implement the new organisation in a safe, organised and controlled manner.**
- **The work was done under the following main frame conditions:**
  - **The present safety level to be maintained and improved according to ISRS objectives.**
  - **Existing production profiles and contractual obligations.**

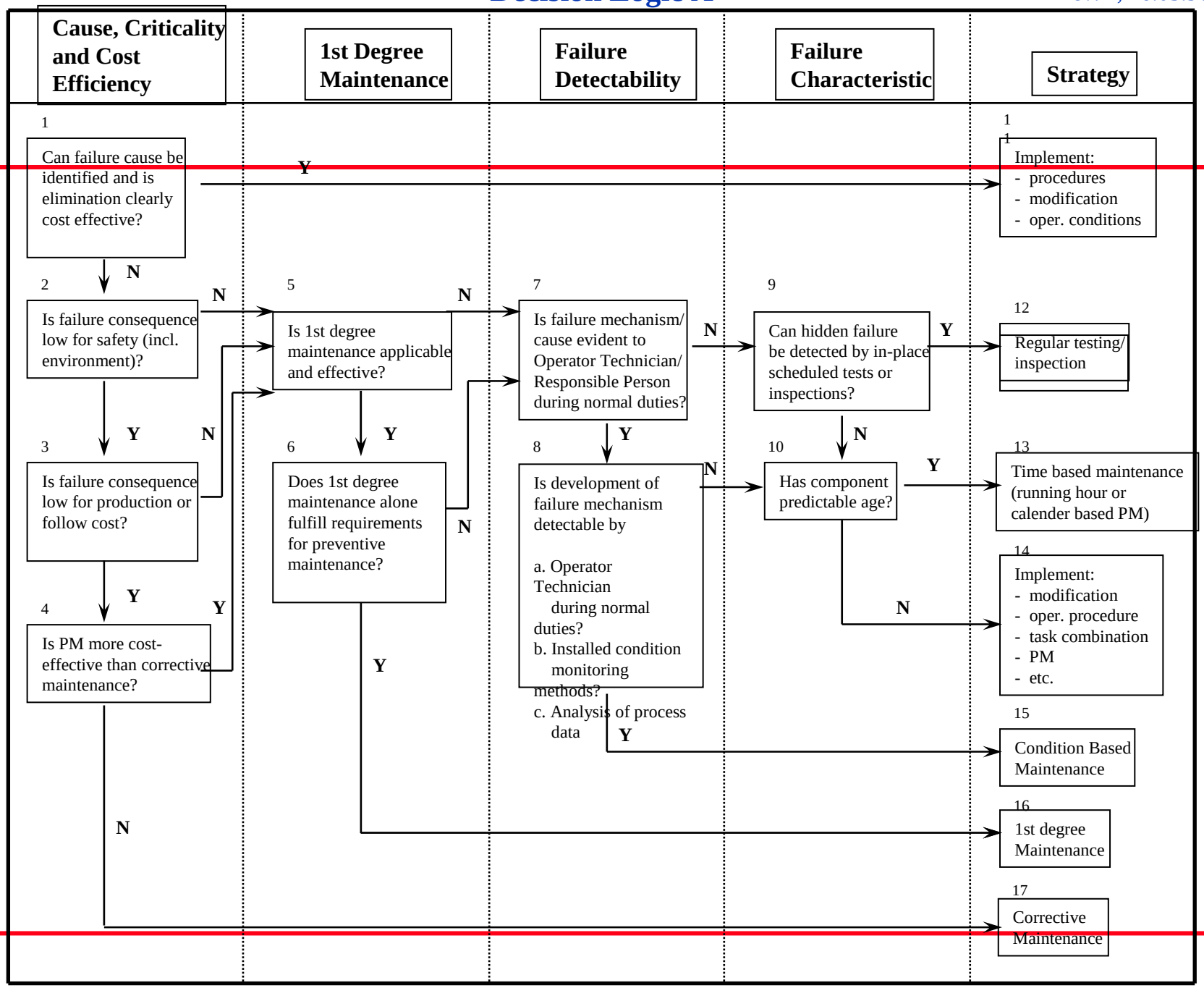
TOTAL

Frigg and Heimdal - Future Operations
Criticality Work / RCM - Methodology



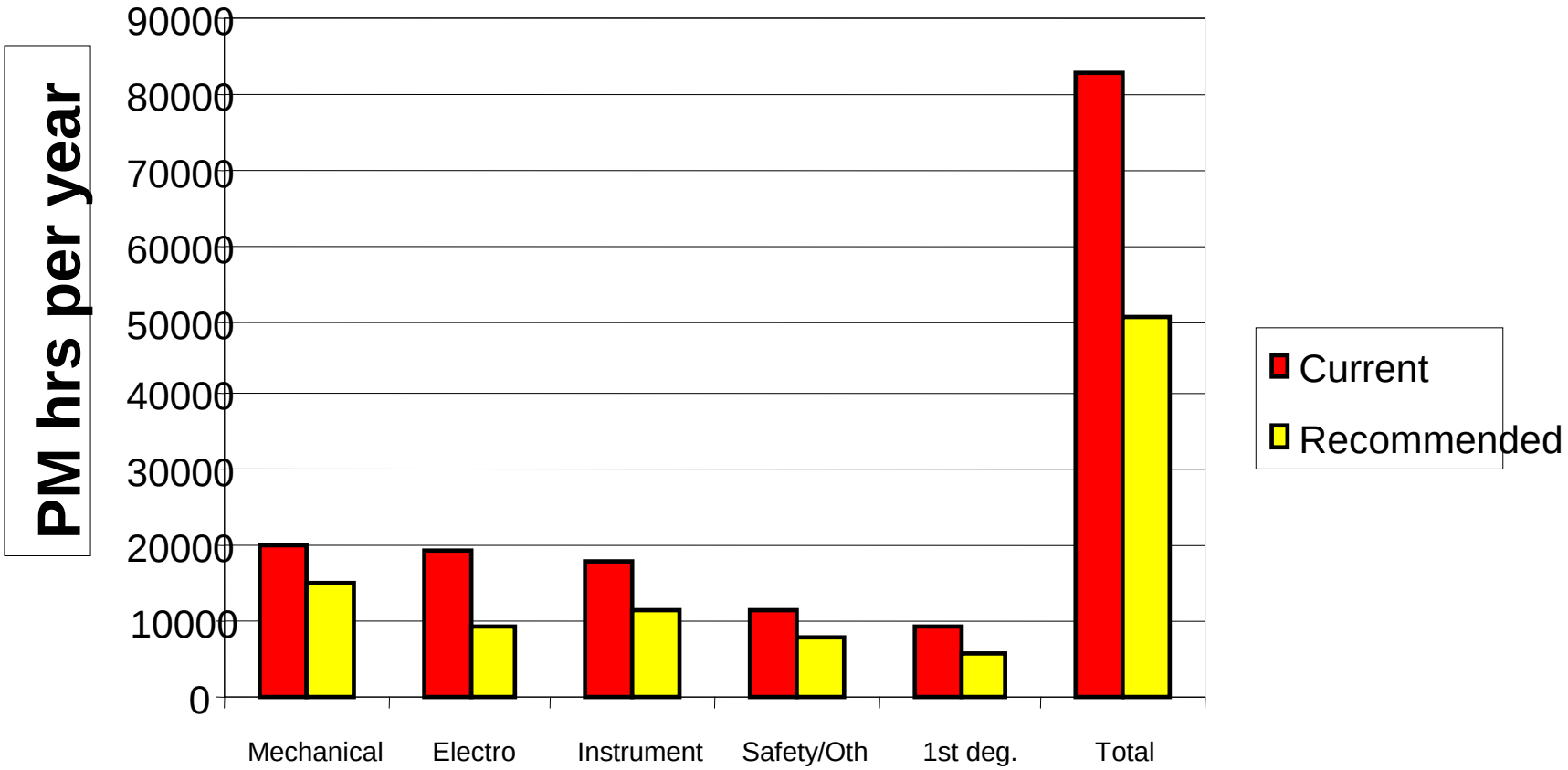
Decision Logic A

Rev. 4, 26.03.96



Frigg & Heimdal - Future Operations Reliability Centered Maintenance (RC

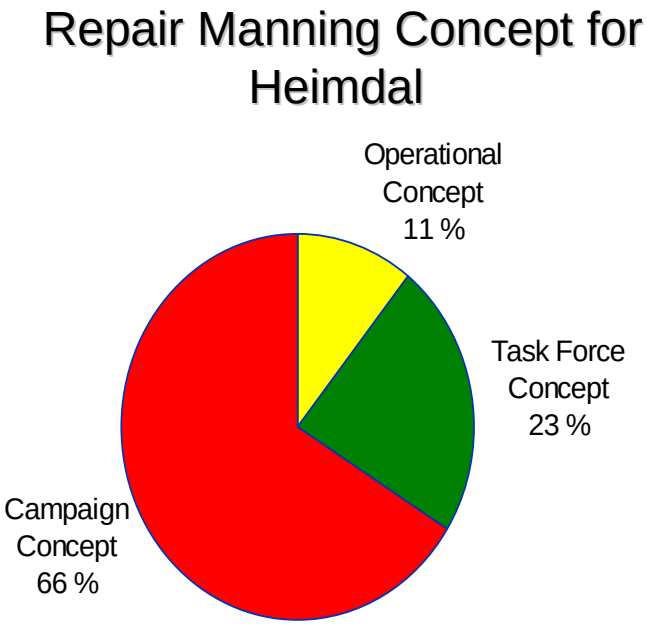
Results - Sum of Frigg & Heimdal

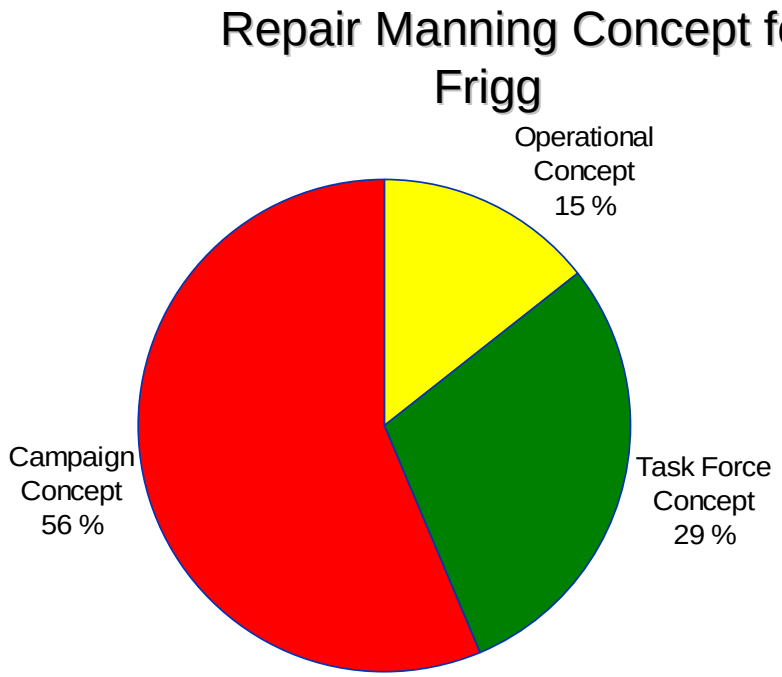


TOTAL

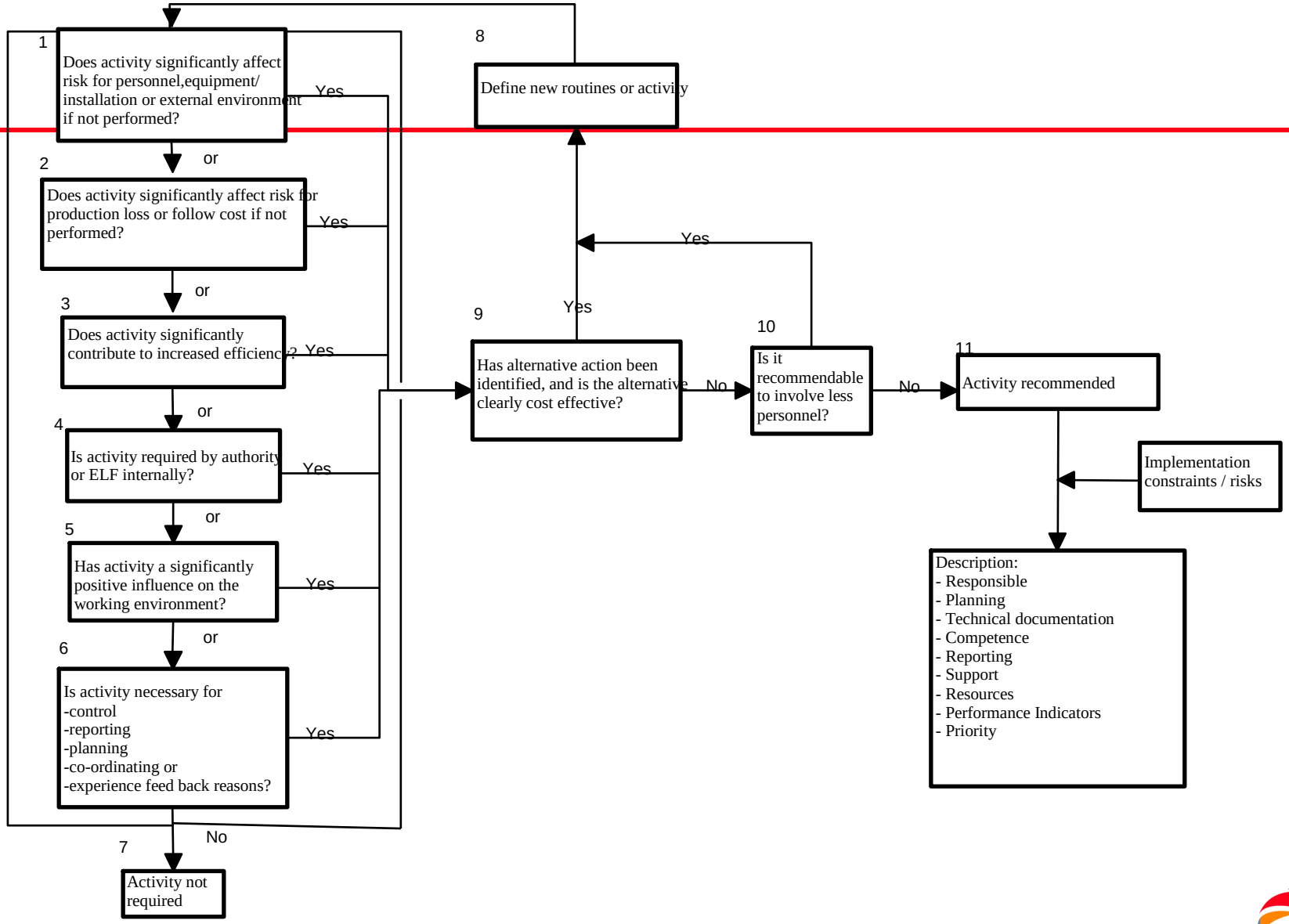
Frigg & Heimdal - Future Operations

Corrective Maintenance Analysis - Main Results





RCO – Criticality Assessment of activities (other than maintenance)



FUTOP Project – the results

- **40% reduction of preventive maintenance hrs. with no increase in curative maintenance. Safety level & production reliability maintained.**
- **Only 11-15% of the equipment break-downs are so critical, that they need immediate repair by fixed platform organisation, which let to the introduction of campaign maintenance with increased efficiency of 15-20%.**
- **26% reduction of operational man-hrs. through criticality assessment of all activities other than maintenance (RCO)**
- **Complete change of organisational principles to a flat multiskilled team based organisation with direct equipment responsibility. Elimination of first line supervisors. Reduction of 26 offshore positions (78 persons).**

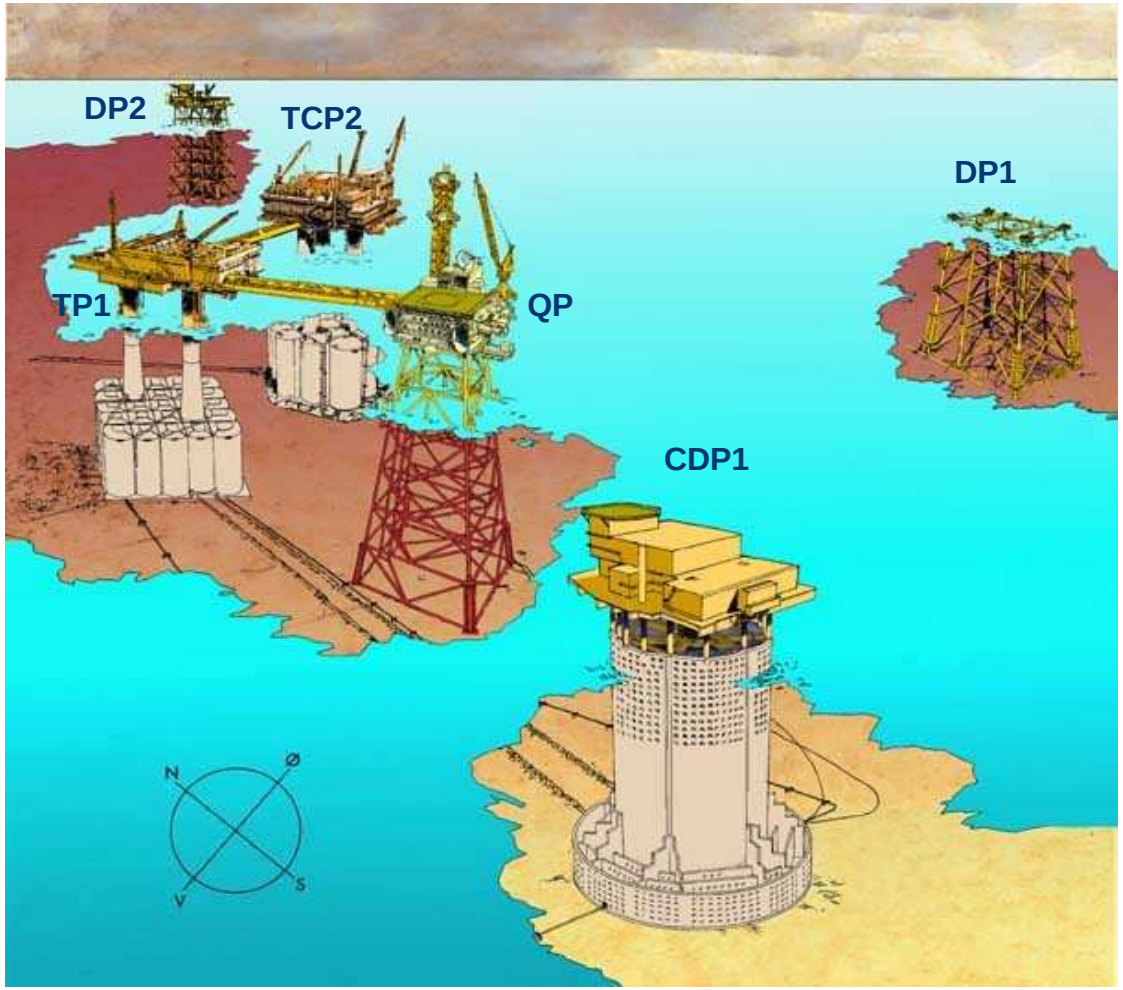
- **OPEX reduction of 16 M€/Year.**
- **Four year prolongation of the production period.**
- **Economical cut off: 1MSm3/day at a production cost at 5$/boe.**

TOTAL

FUTOP Project – Main lessons learned

- Run it as a project – never underestimate the complexity. Coordinate all change projects in the same period
- Document your base and recommended changes very detailed
- Use your technicians actively- they are smarter than you think!
- Don’t implement before you are absolutely ready – then quick and dirty
- Be ambitious- challenge the limits and they will move. Don’t define absolute goals – then you immediately will be in a negotiation position

Decommissioning of the Frigg Field

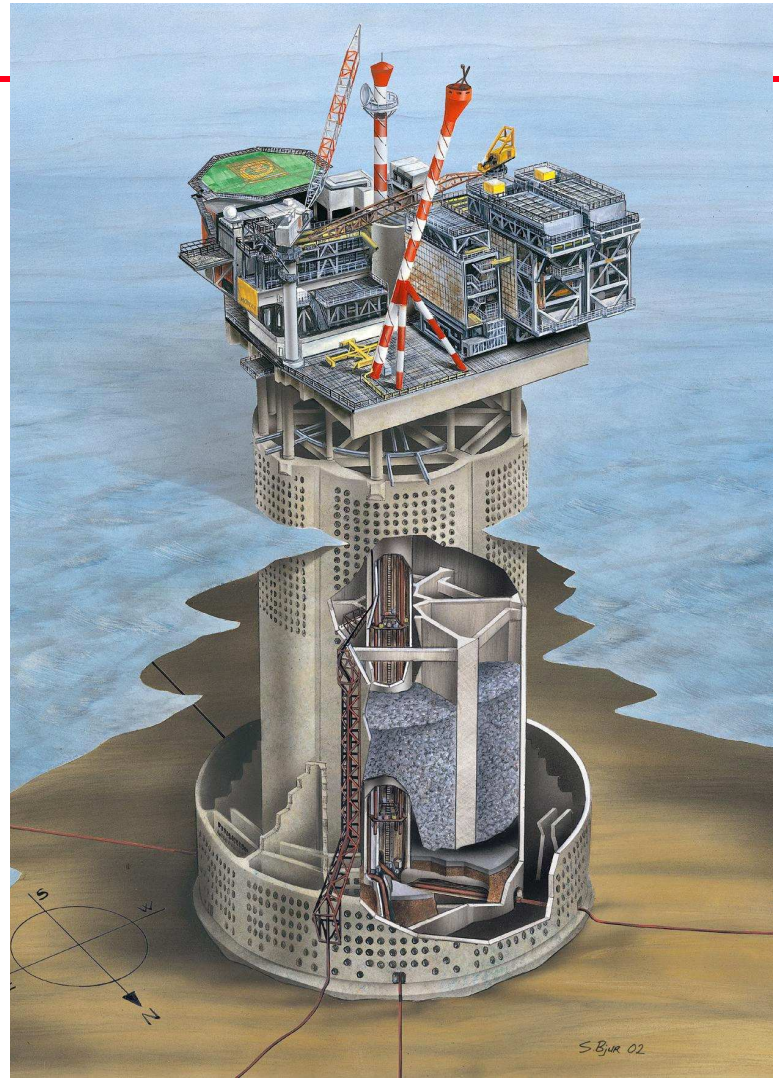


	Sustructure	Topsides
<u>UK</u>		
TP1	162,000 t	8,000 t
QP	4,200 t	3,600 t
CDP1	418,000 t	5,000 t
<u>Norway</u>		
TCP2	229,000 t	23,000 t
DP2	8,500 t	5,500t
DP1	7,300 t	N/A

TOTAL

MCP01

- **Platform Weight :386,000 t**
- **Topsides : 13,500 t**



TOTAL

Regulatory framework

- **World Wide**
  - IMO Guidelines - Safety at sea (min. 55m water depth)
  - London Convention - Controls dumping of waste at sea
- **Regional**
  - OSPAR Convention - Protection of the Marine Environment of the North East Atlantic

superseded in 1998

  - Oslo Convention ('72): Prevent dumping from ships/aircraft
  - Paris Convention ('74): Prevent marine pollution from land

- **National**
  - Norwegian Petroleum Act 1997
  - UK Petroleum Act 1998

Regulatory framework

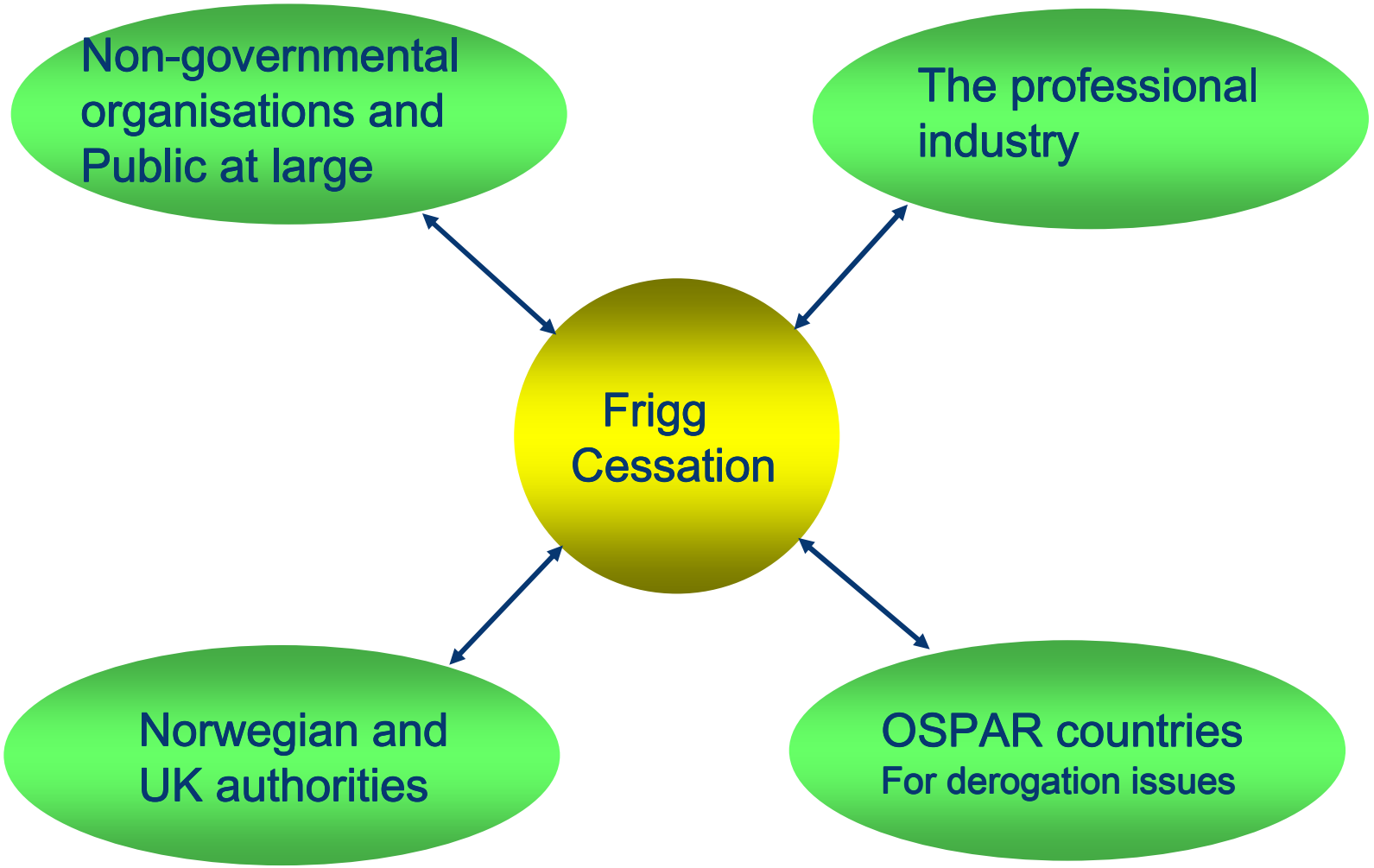
OSPAR Decision 98/3

Disposal at sea, leaving wholly or partly in place disused offshore installations within the maritime area is prohibited

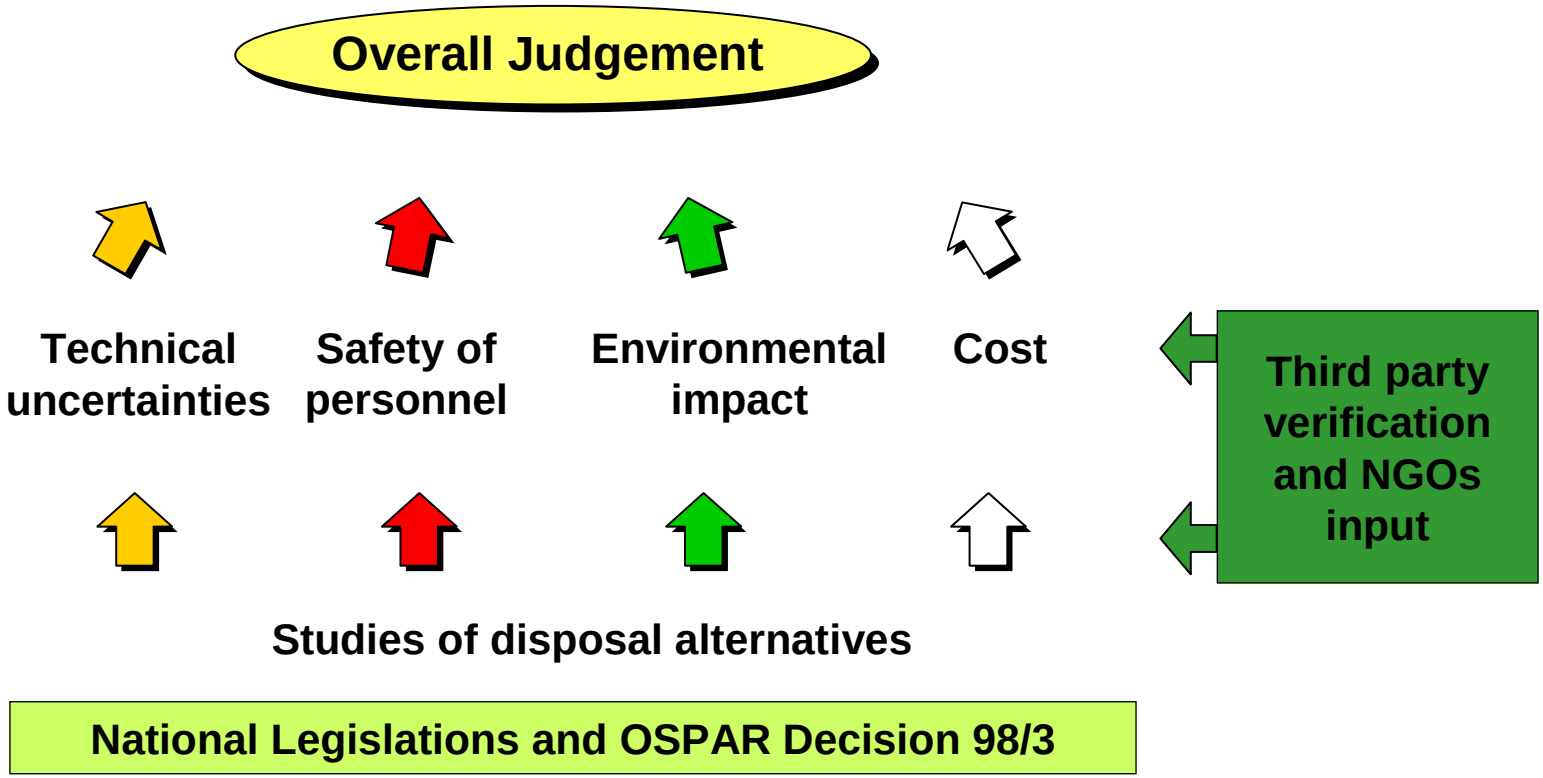
Derogation to the OSPAR Decision:

- **Jackets of steel installations weighing more than 10 000 tonnes of structures emplaced before February 9, 1999 that can apply to leave all or part of the footings**
- **Gravity based concrete structures that can be dumped or left wholly or partly in place**
- **Exceptional and unforeseen circumstances resulting from structural damage or deterioration, or from some other cause presenting equivalent difficulties**

Involved parties



Methodology



Assessment of disposal alternatives – Evaluation principles

The following aspects have been considered when evaluating the various disposal alternatives:-

- **Technical Risk Assessment:**

  Maximum acceptable probability of a major accident during the decommissioning operations (with the associated large financial loss) has been set as **1×10^{-3} (1 in 1000)**

- **Risk to Personnel:**

  The risk of fatality for an individual shall not be greater than **1×10^{-3} per year** (1 in 1000) and **shall be as low as reasonably practicable**

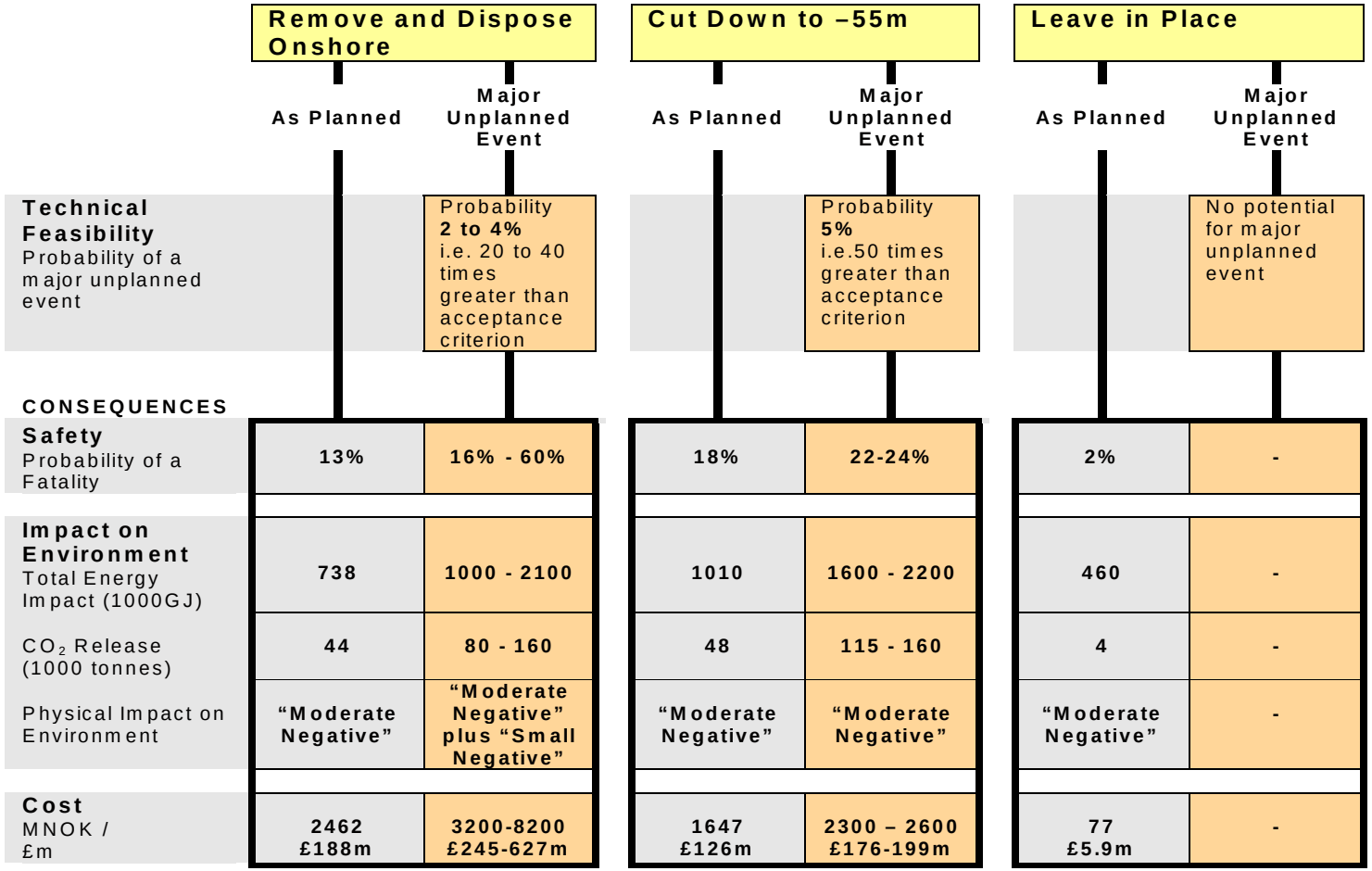
TOTAL

Assessment of disposal alternatives – Evaluation principles

- **Environmental Impact:**
- Energy
- Releases (emissions/discharges) to atmosphere, sea, water or ground
- Physical impact on the environment
- Aesthetic impact including noise, smell and visual effects
- Waste/resources management
- Littering
- *Social / Community Impacts:*
- Fisheries and free passage at sea
- Employment effects and other social impacts

- **Cost**
- **Views from the NGOs**

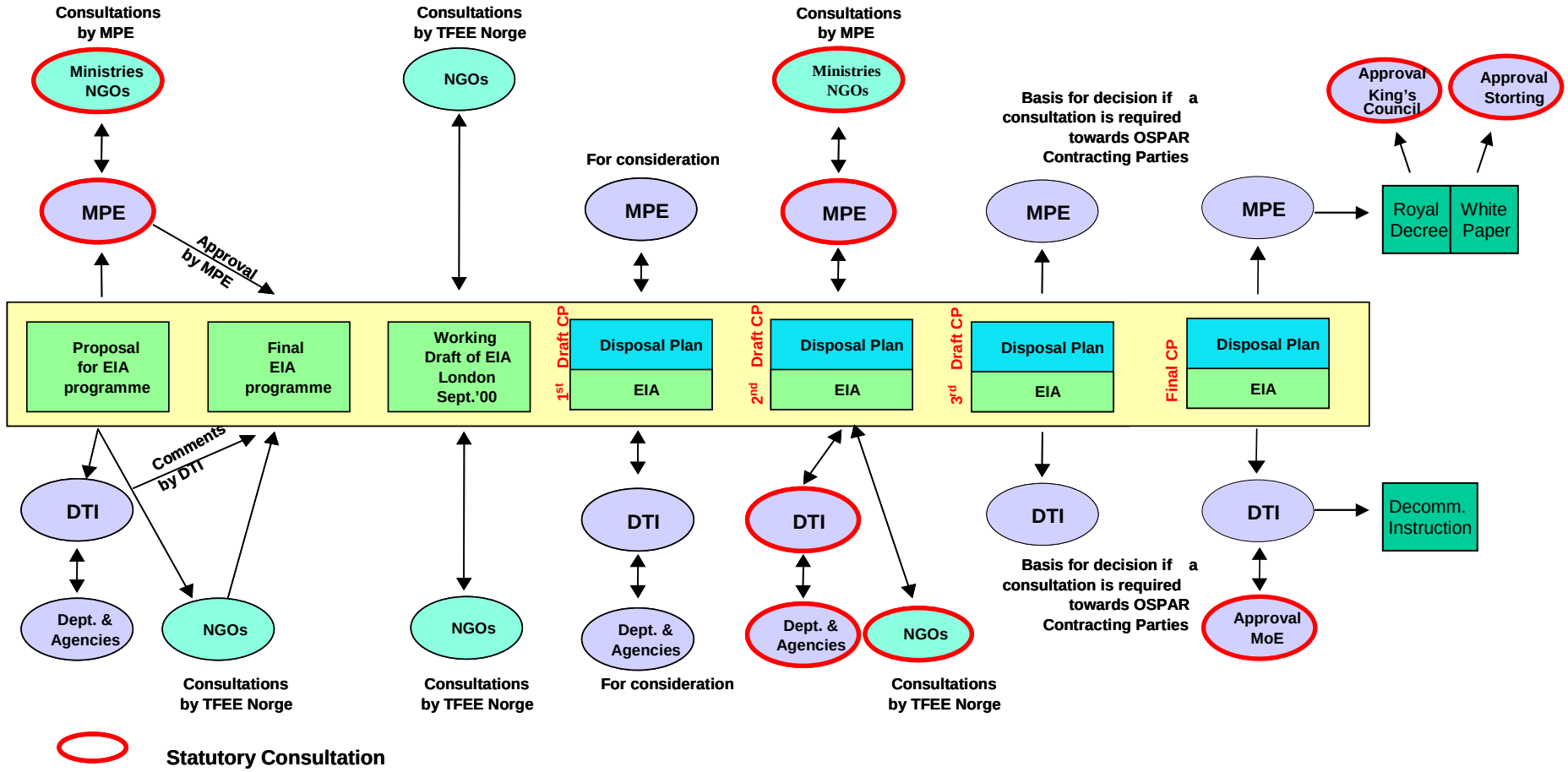
Predicted Consequences of Different Disposal Alternatives for the TCP2 Concrete Substructure



	Remove and Dispose Onshore		Cut Down to –55m		Leave in Place	
	As Planned	Major Unplanned Event	As Planned	Major Unplanned Event	As Planned	Major Unplanned Event
Technical Feasibility Probability of a major unplanned event		Probability **2 to 4%** i.e. 20 to 40 times greater than acceptance criterion		Probability **5%** i.e.50 times greater than acceptance criterion		No potential for major unplanned event
CONSEQUENCES						
Safety Probability of a Fatality	13%	16% - 60%	18%	22-24%	2%	-
Impact on Environment Total Energy Impact (1000GJ)	738	1000 - 2100	1010	1600 - 2200	460	-
CO_2 Release (1000 tonnes)	44	80 - 160	48	115 - 160	4	-
Physical Impact on Environment	"Moderate Negative"	"Moderate Negative" plus "Small Negative"	"Moderate Negative"	"Moderate Negative"	"Moderate Negative"	-
Cost MNOK / £m	2462 £188m	3200-8200 £245-627m	1647 £126m	2300 – 2600 £176-199m	77 £5.9m	-

TOTAL

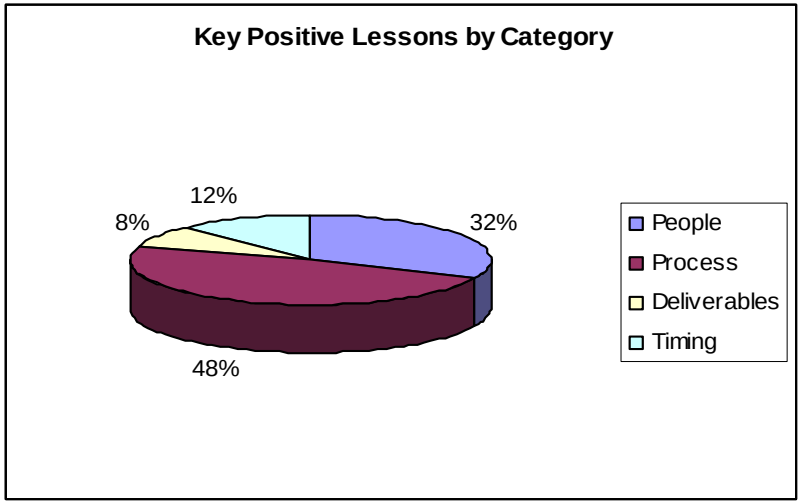
Frigg Field Approval Process



MPE: Ministry of Petroleum and Energy, Oslo, Norway
DTI: Department of Trade and Industry, Aberdeen, UK
NGO: Non Governmental Organisations

Lessons learnt

- ”People” and ”Process” was more difficult than ”Deliverables” and ”Timing”
- Use senior personnel to front the stakeholders (don’t use “communication people”)



- Independent peer review of technical documentation provided objectivity that was valuable in the dialogue with NGOs
- The use of the animated DVD was useful in making technical difficulties understood amongst non-technical people
- Openness and transparency important, it was noticed and appreciated by the NGOs
- Proactive: bring up unpleasant issues
- Deliver on promises; if you can’t deliver don’t promise

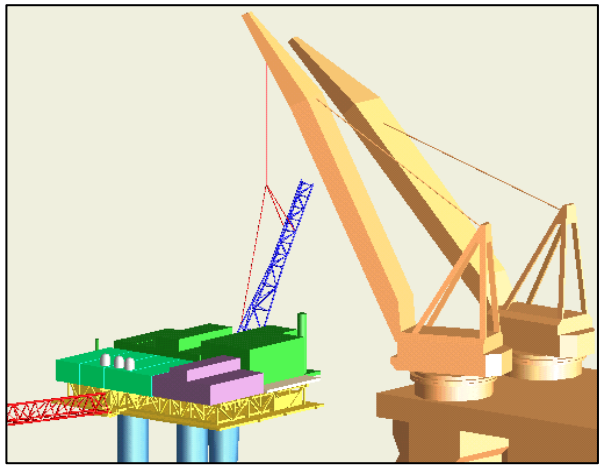
Project Scope

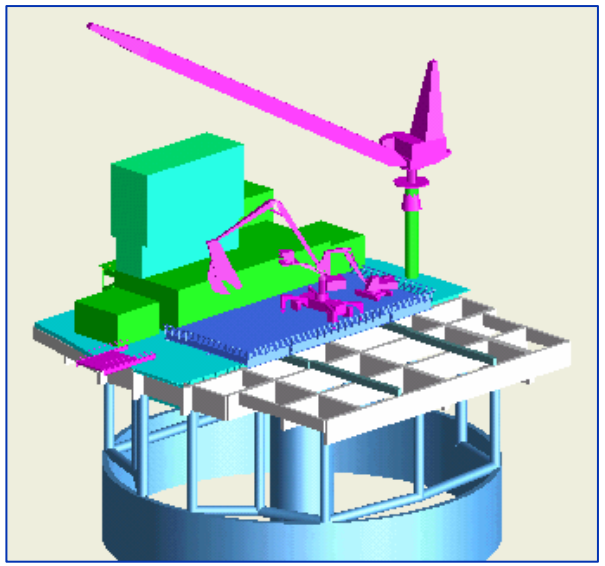
- Decommissioning of Frigg Field and MCP-01 platforms.
  - Cleaning (making hydrocarbon free) of all Frigg Platforms. MCP01 cleaning done by TEP UK.
  - Removal and disposal of all topsides (CDP1, DP2, TP1, TCP2, QP, MCP-01)
  - Removal and disposal of all steel jackets are to be removed (DP2, QP, DP1).
  - All concrete platforms are to be left in place after removal of external steel and beaconing (Navaids).
  - Removal and disposal of all Frigg subsea lines (infield and interfield) and cables are to be removed within the 500 m zone (not for MCP-01).
  - Frigg disposal of topsides and jackets is to be finished by end of 2012 as per approved Cessation Plan.

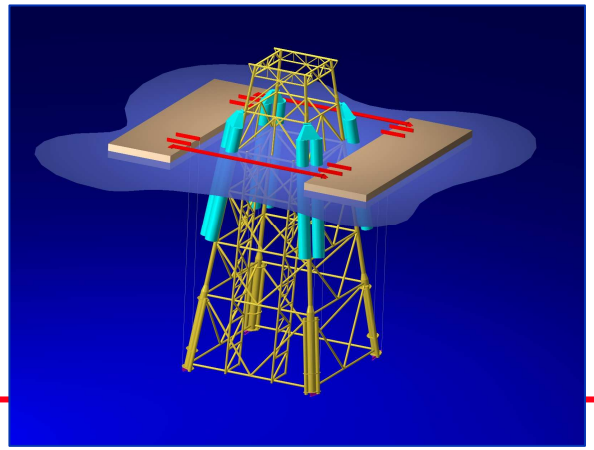
TOTAL

AKOP/Saipem

- Heavy lift by Saipem's S 7000.
- Transport to shore by S 7000 (one barge transport TCP2 MSF).
- Piece Small removal of MCP01 and CDP01 and use of flotel.
- Removal of jackets and transport by flotation.
- Subsea works by SonSub (ENI)







TOTAL

Incentives & Project Objectives

- Contractual Incentives
  - Safety incentive in EPRD contract for offshore works based on anomalies (~ 400 m-h per anomaly) and no severe accidents (LTIF < 3) per calendar year.
  - Environment incentive on recycling (not going to land fill) (> 99 %).
- Project Objectives
  - Zero (0) fatalities
  - TRIR < 6.4 in 2005 with an annual decrease of 15%.
  - LTIF <2.3 in 2005 with an annual decrease of 15%.
  - Zero (0) Environmental Contamination Incidents (ECI) to air or to sea
  - Less than 2,0% (weight) of removed material disposed of at a landfill.

TOTAL

TCP2 (Aug - Oct 05)

DP2 abandonment with Mærsk Innovator

Navigation aids – the end