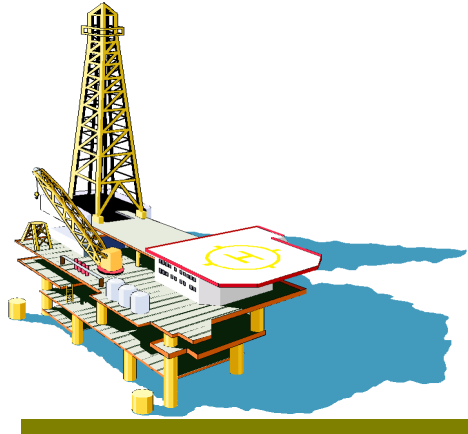
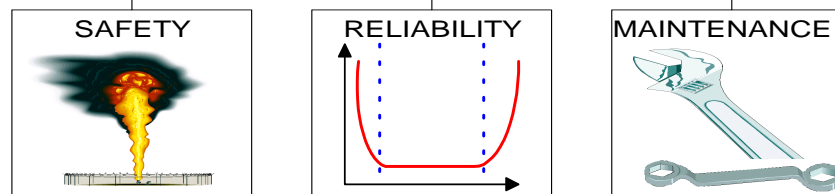


# OREDA<sup>®</sup>



OREDA<sup>®</sup>



ConocoPhillips



ExxonMobil



OREDA<sup>®</sup>

OFFSHORE RELIABILITY DATA

# WHAT OREDA IS

- A project organization with 8 oil and gas companies as members (2009)
- A comprehensive databank with reliability data collected from different worldwide offshore installations
- A forum for exchange and development of reliability methods and know-how within the oil and gas industry



# GENERAL OREDA OBJECTIVES

- **Improve safety**
  - by providing experience and data on risks
- **Improve reliability and availability**
  - by use of reliability data to select most reliable equipment and configuration, and reveal weak designs for future improvement
- **Improve maintenance effectiveness**
  - by using failure data to refine maintenance strategies
- **Enhance industry reputation**
  - by demonstrating a high degree of understanding of equipment performance and characteristics

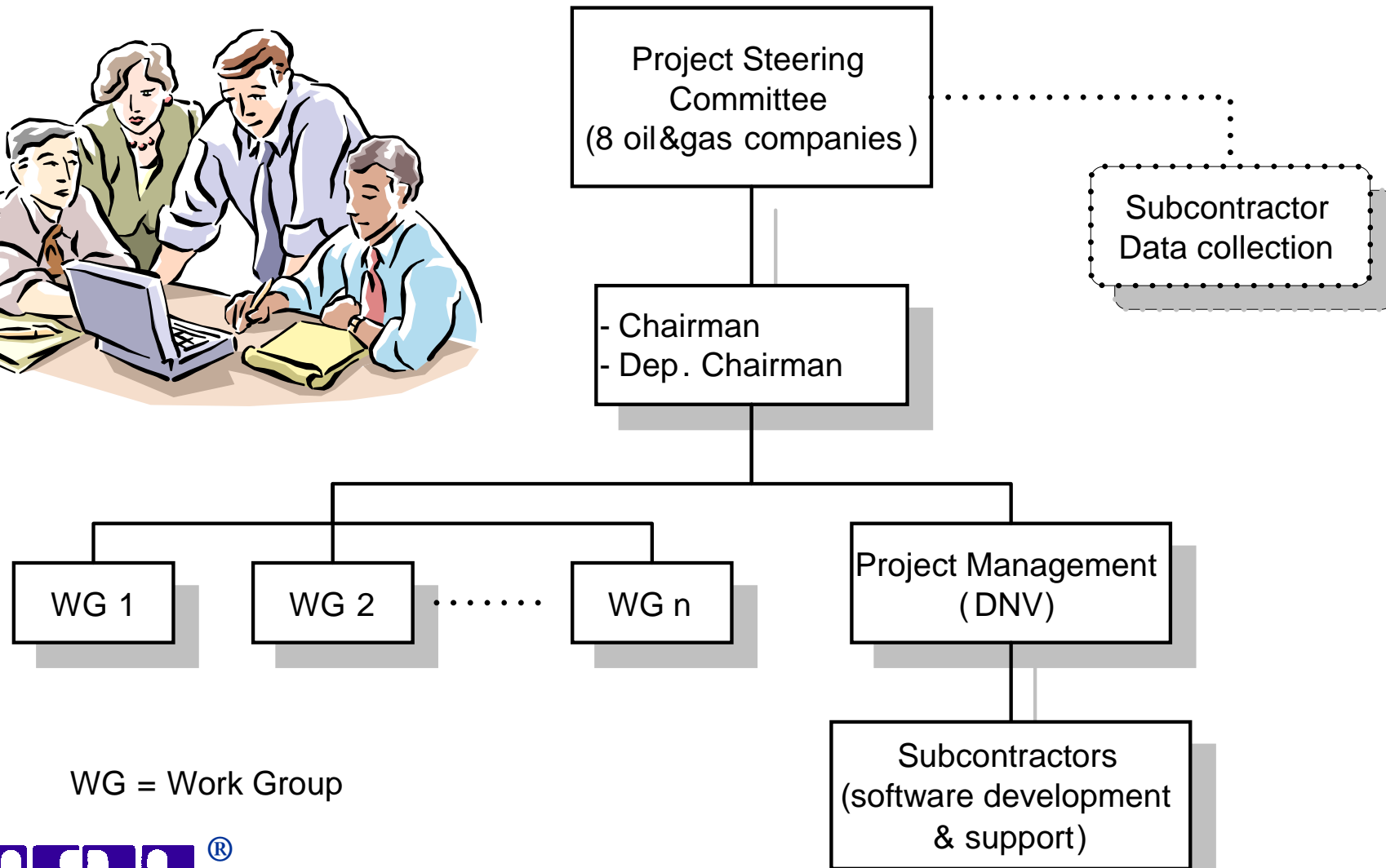


# SPECIFIC OBJECTIVES

- **Collect and exchange operating experience in a common format**
- **Promote reliability engineering in E & P projects**
- **Develop a reference for the collection and analysis of reliability data in the oil and gas industry**
- **Develop cost-efficient data collection methods and tools**
- **Feed back operating experience to the equipment manufacturers**
- **Co-operate with other organizations and research institutes on data collection and analysis**



# ORGANISATION



WG = Work Group



# OREDA HISTORY



Phase	Time period	No. of participating companies	Achievements and milestones
I	1981-84	8	<ul style="list-style-type: none"> <li>• OREDA Reliability Data Handbook ('84 edition)</li> </ul>
II	1985-88	7	<ul style="list-style-type: none"> <li>• Issued phase II reliability database</li> <li>• Guideline for Data Collection</li> <li>• Software for data storage and analysis (DOS).</li> </ul>
III	1990-92	10	<ul style="list-style-type: none"> <li>• Issued phase III reliability database</li> <li>• 2nd Handbook issued ('92 edition)</li> <li>• Initiated vendor cooperation</li> </ul>
III-IV	1993	10	<ul style="list-style-type: none"> <li>• Data analysis methods developed and tested</li> <li>• Cost-benefit study</li> <li>• Promoted the OREDA concept as ISO Standard</li> </ul>
IV	1994-96	10	<ul style="list-style-type: none"> <li>• New software for data collection and analysis (Windows)</li> <li>• Collected data on preventive maintenance</li> <li>• New Guideline, also included in new software</li> </ul>
V	1997-99	10 - 11	<ul style="list-style-type: none"> <li>• 3<sup>rd</sup> Handbook issued ('97 edition)</li> <li>• ISO 14 224 issued (first edition)</li> <li>• New subsea software</li> <li>• Software tool for automated data transfer (ADT)</li> </ul>
VI	2000-01	10	<ul style="list-style-type: none"> <li>• Strengthen focus on subsea equipment</li> <li>• Co-operation with subsea manufacturers established</li> </ul>
VII	2002-03	8	<ul style="list-style-type: none"> <li>• 4<sup>th</sup> Handbook issued (2002 edition)</li> <li>• Focus on safety &amp; subsea equipment</li> </ul>
VIII	2004-05	9	<ul style="list-style-type: none"> <li>• Continuation of phase VII</li> <li>• New associated member (Gassco)</li> <li>• Involved in revised ISO 14 224 Standard (second edition)</li> </ul>
IX	2006-08	9	<ul style="list-style-type: none"> <li>• OREDA seminar as part of 25 years anniversary (2006)</li> <li>• Adoption of OREDA taxonomy and software to ISO 14 224</li> <li>• Continued focus on worldwide span of data coverage</li> </ul>
X	2009-11	8	<ul style="list-style-type: none"> <li>• Continuation of phase IX</li> <li>• 5<sup>th</sup> Handbook planned to be issued (2009)</li> </ul>



# MAIN OREDA ACHIEVEMENTS

- Existed in 28 years (2009) as an international joint industry project with 7-11 international oil and gas companies from 5 countries as members
- Established as the forum for collection and exchange of reliability data, and utilisation of reliability methods within the oil & gas industry
- A comprehensive databank with Exploration & Production (E&P) reliability data collected worldwide on:
  - Offshore topside and subsea equipment
  - Onshore E & P equipment
- Developed guidelines and software for data collection and analysis, topside and subsea
- Issued 4 comprehensive reliability data handbooks ('84, '92, '97 and '02) that have been sold worldwide (>50 countries)
- Established a collaboration forum with subsea system suppliers
- Developed an ISO Standard based on the OREDA concept (ISO 14 224)
- ~ 40 Papers at various seminars and conferences



# OREDA RELIABILITY DATA HANDBOOK - 4th. EDITION (2002)

System	Equipment class	Phase IV - Handbook 2002 - (1993 – 96)	Phase V (1997 – 00)	SUM
		No. of units	No. of units	No. of units
<b>Rotating machinery</b>	- Gas Turbines	56	28	84
	- Compressors	75	56	131
	- Combustion engines	39	64	103
	- Pumps	294	152	446
	- Turboexpanders	7	8	15
	- Electric generators	87	8	95
	- Electric motors	56	122	178
<b>Static equipment</b>	- Vessels	148	51	199
	- Heaters and boilers	8	1	9
	- Heat exchangers	51	17	68
<b>Other topside equipment</b>	- Valves	821	349	1170
	- F&G detection equipment	79	779	858
	- Process sensors/control	140	69	209
<b>Subsea equipment</b>	- Control systems		17	17
	- Wellhead & X-mas tree		83	83
	- Pipelines		144	144
	- Template		4	4
	- Manifold		29	29
	- Risers		42	42
	- Running tools		6	6
<b>Total</b>		<b>1861</b>	<b>2029</b>	<b>3890</b>



# EXAMPLE PAGE OREDA HANDBOOK (4th. EDITION)

Taxonomy no		Item								
2.2.2.13		Electric Equipment Electric motors Pump Oily water treatment								
Population	Installations	Aggregated time in service (10 <sup>6</sup> hours)						No of demands		
		Calendar time *	Operational time †							
9	1	0.3039	0.2406							
Failure mode	No of failures	Failure rate (per 10 <sup>6</sup> hours)					Active rep.hrs	Repair (manhours)		
		Lower	Mean	Upper	SD	n/τ		Min	Mean	Max
<b>Critical</b>	15*	<b>30.42</b>	<b>49.36</b>	<b>76.00</b>	<b>49.36</b>	<b>49.36</b>	<b>9.8</b>	<b>3.0</b>	<b>18.3</b>	<b>39.0</b>
	15 <sup>†</sup>	<b>38.42</b>	<b>62.34</b>	<b>95.99</b>	<b>62.34</b>	<b>62.34</b>				
Breakdown	3*	2.70	9.87	25.52	9.87	9.87	11.2	8.0	19.7	27.0
	3 <sup>†</sup>	3.41	12.47	32.23	12.47	12.47				
Fail to start on demand	3*	2.70	9.87	25.52	9.87	9.87	8.2	3.0	14.3	37.0
	3 <sup>†</sup>	3.41	12.47	32.23	12.47	12.47				
Spurious stop	2*	1.17	6.58	20.72	6.58	6.58	4.0	5.0	5.5	6.0
	2 <sup>†</sup>	1.48	8.31	26.16	8.31	8.31				
Structural deficiency	3*	2.70	9.87	25.52	9.87	9.87	10.8	4.0	21.7	39.0
	3 <sup>†</sup>	3.41	12.47	32.23	12.47	12.47				
Vibration	4*	4.49	13.16	30.13	13.16	13.16	12.0	7.0	24.0	38.0
	4 <sup>†</sup>	5.67	16.62	38.05	16.62	16.62				
<b>Degraded</b>	10*	<b>17.85</b>	<b>32.91</b>	<b>55.81</b>	<b>32.91</b>	<b>32.91</b>	<b>6.4</b>	<b>3.0</b>	<b>11.9</b>	<b>32.0</b>
	10 <sup>†</sup>	<b>22.55</b>	<b>41.56</b>	<b>70.49</b>	<b>41.56</b>	<b>41.56</b>				
Overheating	1*	0.16	3.29	15.62	3.29	3.29	3.0	6.0	6.0	6.0
	1 <sup>†</sup>	0.21	4.16	19.72	4.16	4.16				
Structural deficiency	5*	6.48	16.45	34.60	16.45	16.45	7.4	3.0	13.4	32.0
	5 <sup>†</sup>	8.19	20.78	43.70	20.78	20.78				
Vibration	4*	4.49	13.16	30.13	13.16	13.16	5.5	10.0	11.0	12.0
	4 <sup>†</sup>	5.67	16.62	38.05	16.62	16.62				
<b>Incipient</b>	3*	<b>2.70</b>	<b>9.87</b>	<b>25.52</b>	<b>9.87</b>	<b>9.87</b>	<b>2.0</b>	<b>2.0</b>	<b>2.0</b>	<b>2.0</b>
	3 <sup>†</sup>	<b>3.41</b>	<b>12.47</b>	<b>32.23</b>	<b>12.47</b>	<b>12.47</b>				
Minor in-service problems	3*	2.70	9.87	25.52	9.87	9.87	2.0	2.0	2.0	2.0
	3 <sup>†</sup>	3.41	12.47	32.23	12.47	12.47				
<b>Unknown</b>	1*	<b>0.16</b>	<b>3.29</b>	<b>15.62</b>	<b>3.29</b>	<b>3.29</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>
	1 <sup>†</sup>	<b>0.21</b>	<b>4.16</b>	<b>19.72</b>	<b>4.16</b>	<b>4.16</b>				
Unknown	1*	0.16	3.29	15.62	3.29	3.29	4.0	4.0	4.0	4.0
	1 <sup>†</sup>	0.21	4.16	19.72	4.16	4.16				
<b>All modes</b>	29*	<b>68.27</b>	<b>95.44</b>	<b>130.12</b>	<b>95.44</b>	<b>95.44</b>	<b>7.9</b>	<b>2.0</b>	<b>14.5</b>	<b>39.0</b>
	29 <sup>†</sup>	<b>86.22</b>	<b>120.53</b>	<b>164.34</b>	<b>120.53</b>	<b>120.53</b>				
Comments										



# OREDA EQUIPMENT COVERAGE

<b>Rotating machinery</b>	<b>Mechanical equipment</b>	<b>Control &amp; Safety</b>	<b>Subsea equipment</b>
Combustion engines Compressors Electric generators Electric motors Gas turbines Pumps Steam turbines Turboexpanders	Cranes Heat exchangers Heaters and Boilers Loading arms Swivels Turrets Vessels Winches	Control Logic Units Fire & Gas detectors HVAC Input devices Nozzles Power transformers UPS Valves Frequency converters Switchgear	Control systems Dry tree riser El. power distribution Flowlines Manifolds Pipelines Production risers Running tools Subsea pumps Subsea vessels Templates Wellhead & X-mas trees



# OREDA DATABASE CONTENT

## Topside/onshore data:

- 265 installations
- 16 000 equipment
- 38 000 failures
- 68 000 maintenance records



## Subsea data from:

- Adriatic Sea
- Guinean Gulf
- Gulf of Mexico
- Mediterranean Sea
- North Sea
- West of Africa
- West of Shetland
- Almost 2000 well-years experience

# RECORDED DATA

- **Inventory data**

- **Classification data**
- **Identification data**
- **Specification data**
- **Maintenance data**
- **Operation data**

- **Failure event data**

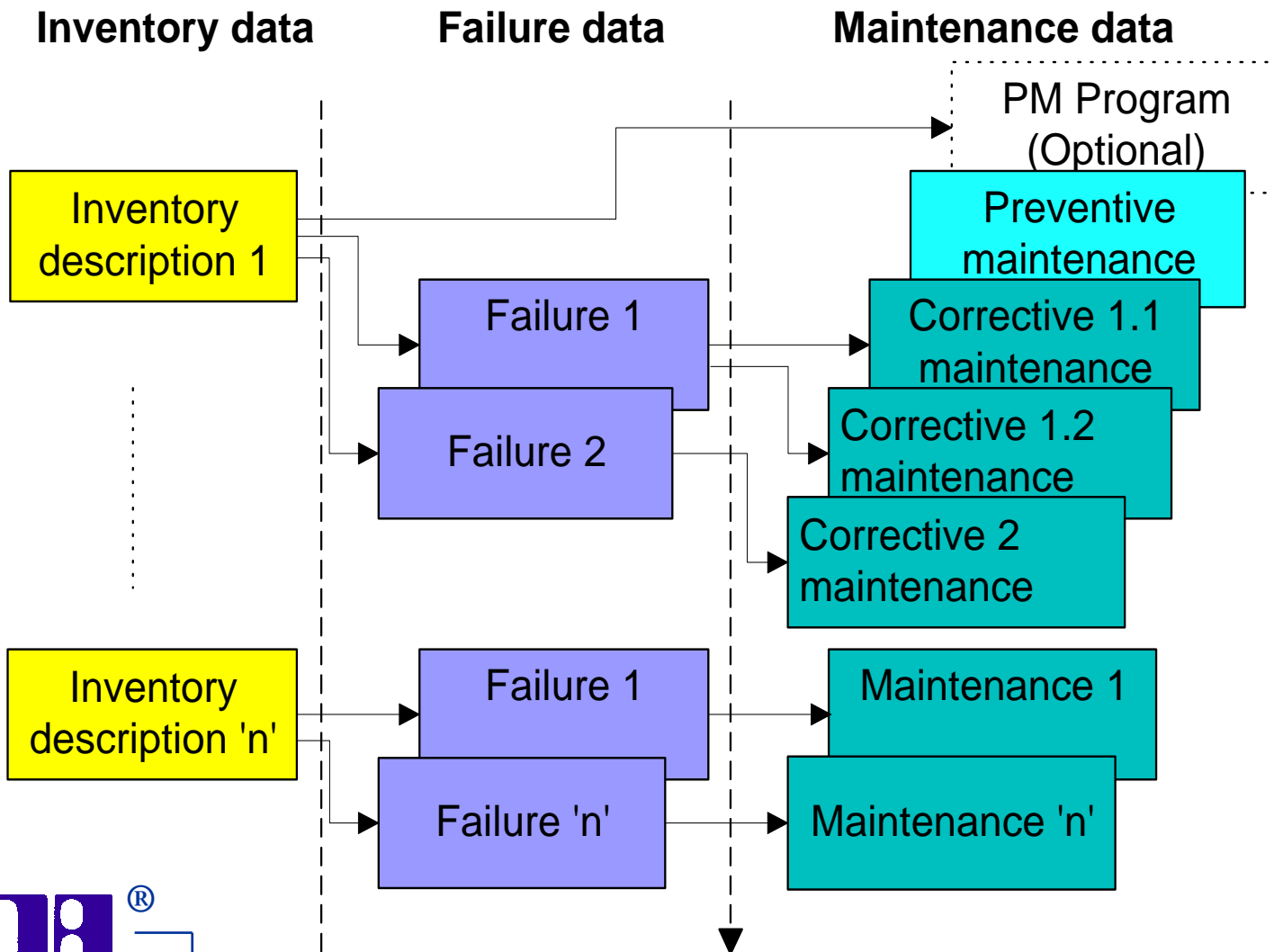
- **Identification**
- **Failure event data**
- **Remarks**

- **Maintenance event data**

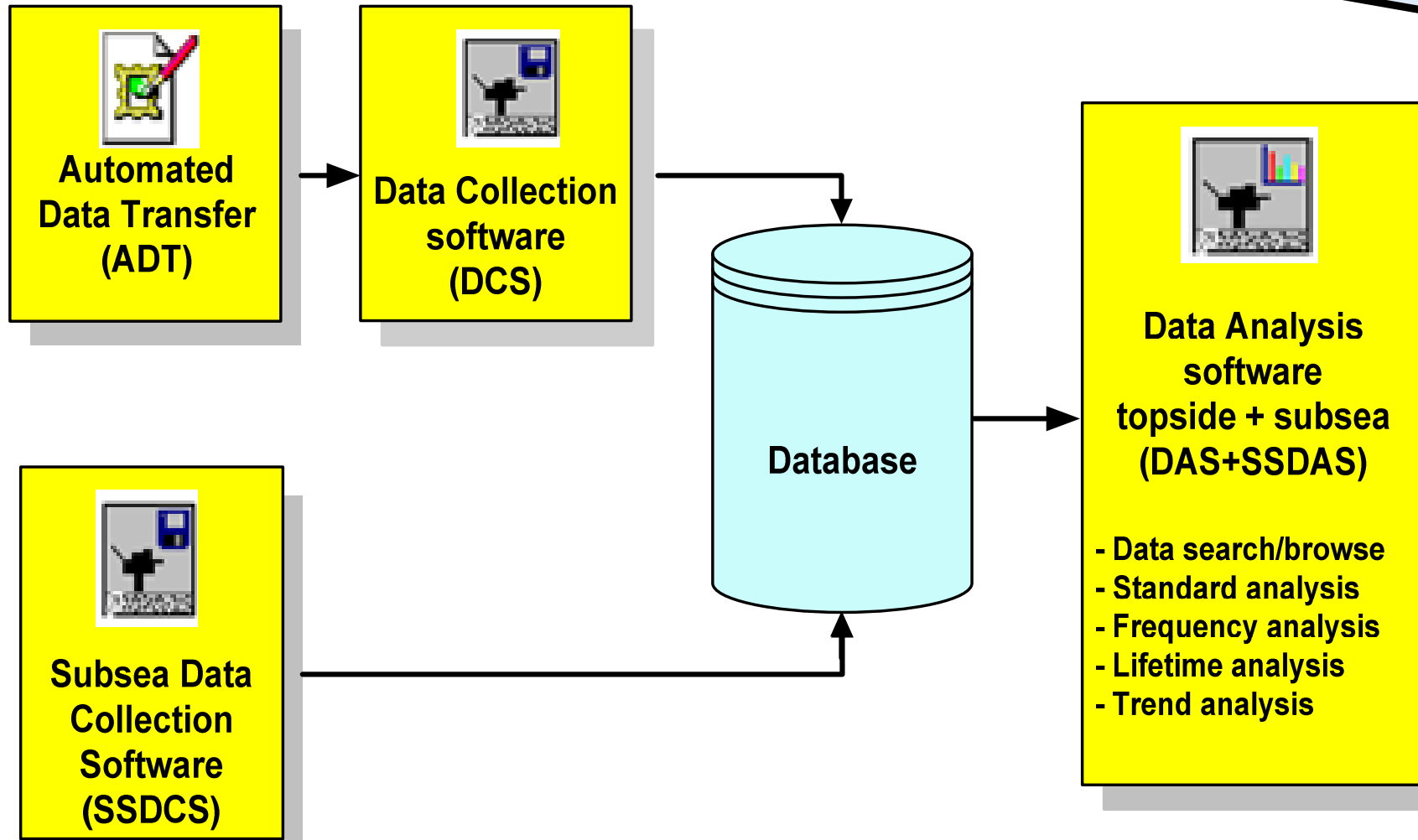
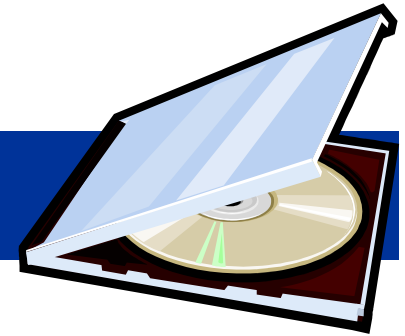
- **Identification**
- **Maintenance event data**
- **Maintenance resources**
- **Remarks**



# DATABASE STRUCTURE - Topside



# OREDA<sup>®</sup> SOFTWARE MODULES



# SOFTWARE FEATURES

## Data handling features

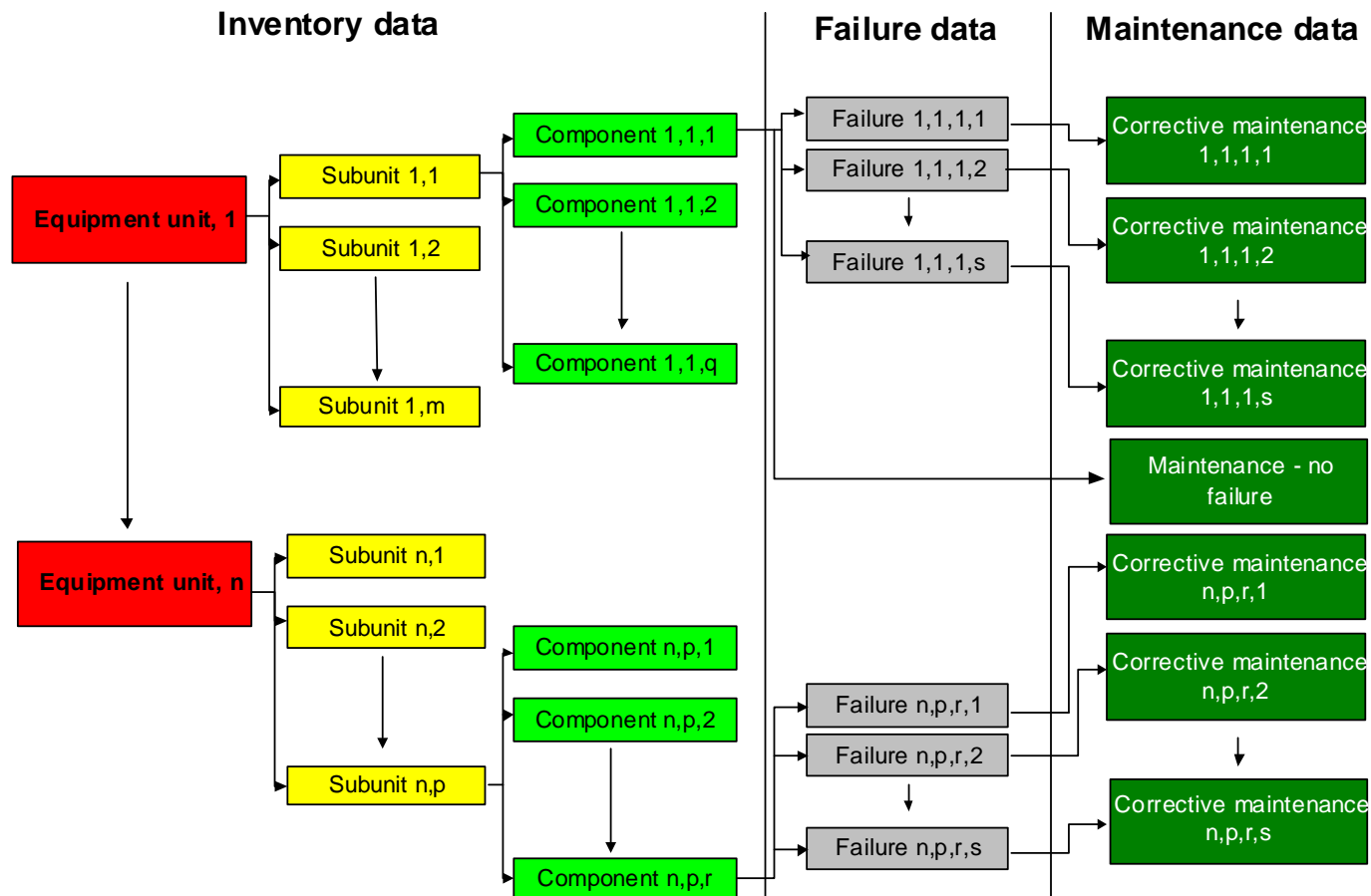
- Focused data search (filtering)
- Editing data
- In-built quality checks
- Time slicing data collection periods
- Import data from various formats
- Creating different data areas
- Access control

## Data analysis features

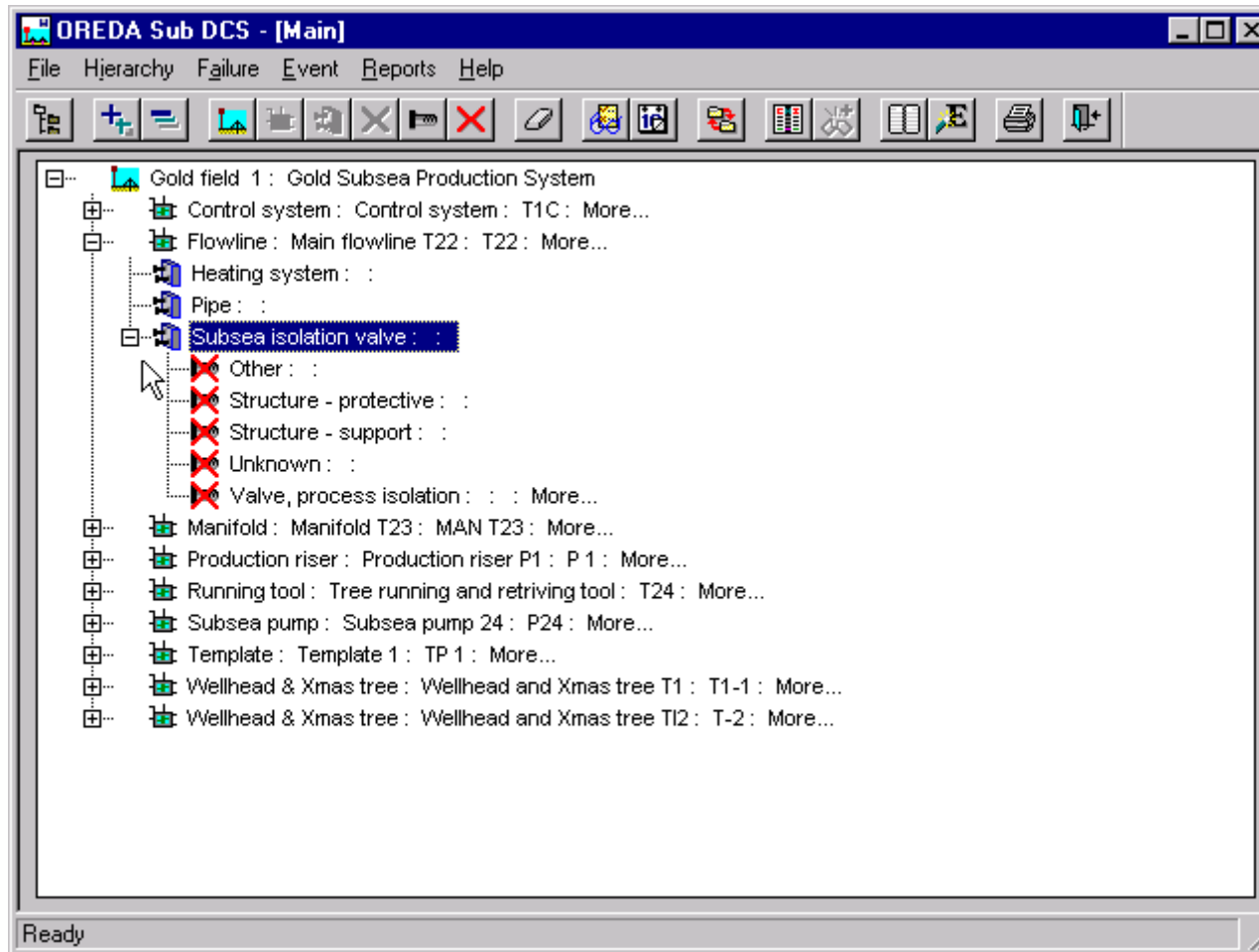
- Database content
- Failure rate/MTBF
- MTTR
- Failure modes
- Subunits/component failures
- Lifetime analysis
- Frequency analysis
- Cumulative analysis
- Export data/calculations



# DATABASE STRUCTURE - Subsea

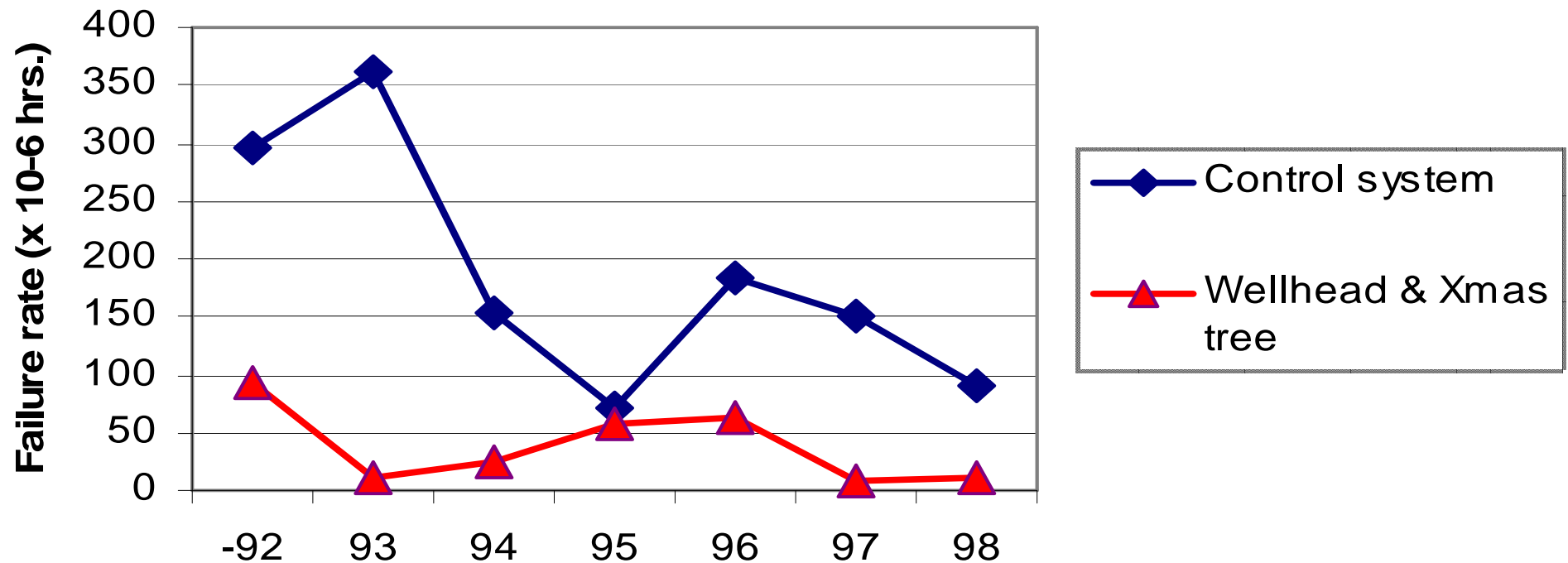


# OREDA DATA COLLECTION SOFTWARE - Subsea



## EXAMPLE ANALYSIS- subsea data

Subsea failure rates for the period 92-98  
- All failures -



# OREDA DATA COLLECTION GUIDELINES

- **Definitions – language we use**
- **Data collection procedure**
- **How to collect inventory data**
- **How to code failures**
- **How to code maintenance**
- **Boundary descriptions**
- **Quality assurance of data**



# DATA QUALITY MEASURES IN OREDA

- **Data collection guidelines**

- data collection specifications (definitions, boundaries etc.)
- hints, tips and interpretation rules
- data collection planning
- quality control requirements

- **Data Collection Software**

- minimum data sets required
- data completion check
- input check (format and limits)
- Specific software for automated data collection

- **Project Manager**

- Help-desk for data collectors, and management of common quality issues
- quality check of data before acceptance to common OREDA database
- issue and updating of quality checklists

- **Data collectors forum**

- data collectors regular meetings
- exchange of common problems and improvement proposals
- exchange on experience with data collection process and method
- formalised cooperation with subsea manufacturers



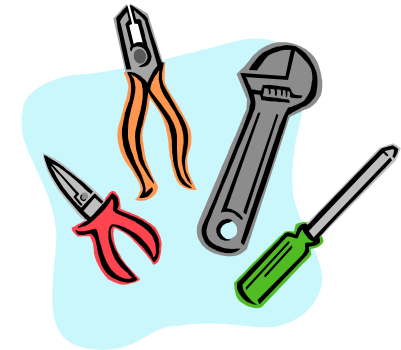
# APPLICATION OF DATA

- Availability studies
  - Availability estimates
  - Design optimization
  - Equipment selection
- Risk analysis
  - Estimate probabilities of critical events
  - Estimate survival time for safety-critical items
- LCC
- Benchmarking
- Maintenance planning and optimization
  - RCM
  - Spare parts requirements
  - Analyze reliability characteristics
  - Reveal weak designs/design improvements
- Operations
  - Condition monitoring
  - Trend monitoring

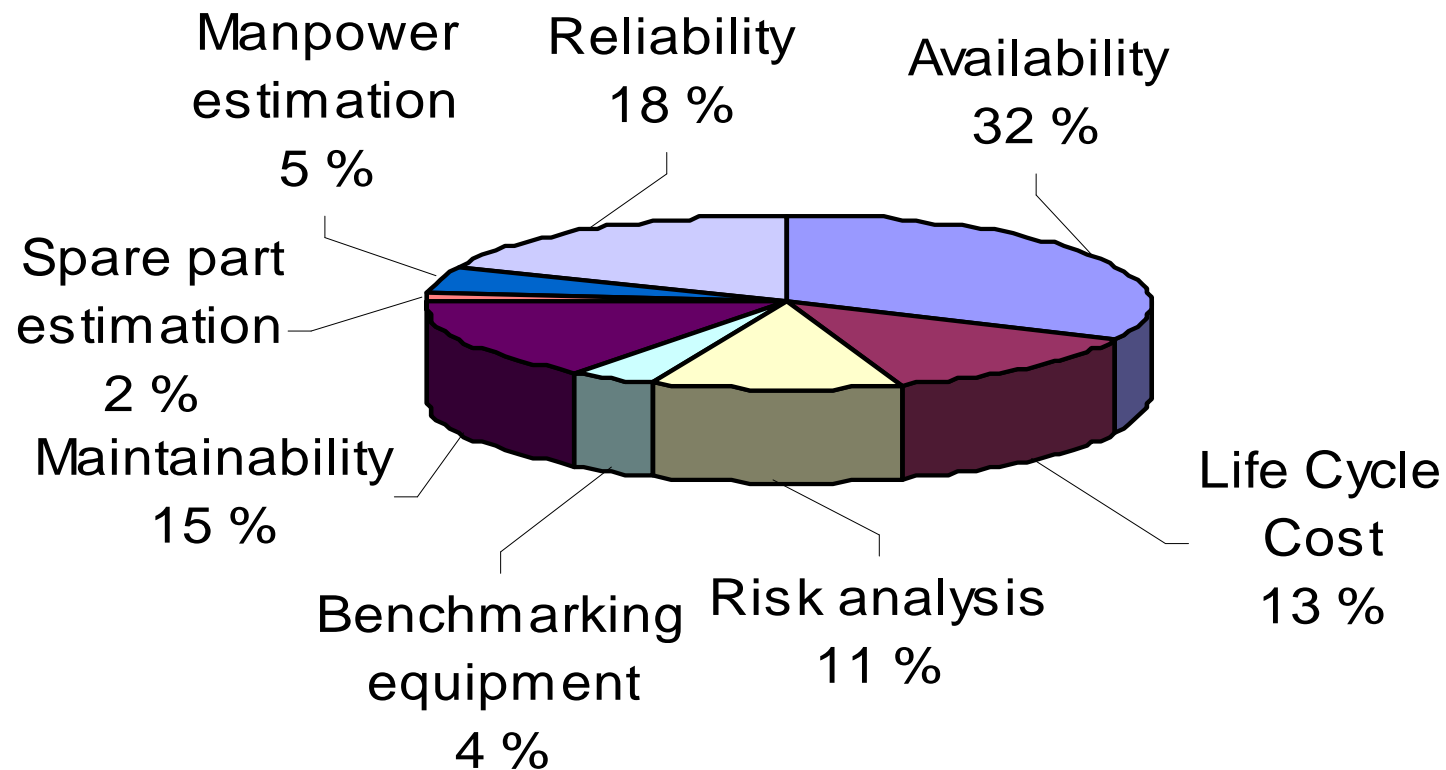


# EXAMPLE: MAINTENANCE OPTIMIZATION

- **Reliability and maintenance records will assist with:**
  - Analysis of failure modes (FMEA)
    - Reveal critical problems
    - Provide lifetime characteristics (failure rate, etc.)
    - Select detection methods to prevent failure (where appropriate)
  - Monitor key maintenance and operability parameters
  - Provide basis for “de-bottlenecking” studies
  - Optimize spare parts strategy
  - Optimize manpower strategy



## APPLICATION OF DATA - EXAMPLE FROM ONE OIL COMPANY



## USE OF OREDA DATA – Specific case

- **Application:** Oil export
- **Installation:** Offshore oil and gas platform
- **Case:** Tie-in of a new field to an existing platform. The new equipment module includes separators, compressors, gas turbine etc. A 2 x 100% oil export system was originally planned.
- **Solution:** A 1 x 100% oil export system was selected consisting mainly of a booster pump and an export pump. Estimated production availability reduced by  $\approx 0.4\%$
- **Cost saving:** Cost:  $\approx$  NOK 50 millions. Weight:  $\approx$  20 tons of equipment,  $\approx$  40 tons bulk. More space available.
- **Analysis:** RAM assessment
- **Use of OREDA data:** OREDA Phase pump data used as input to the RAM assessment



# SUMMARY

- OREDA has become the forum for the collection and exchange of reliability data within the offshore industry, and used as model for data collection within other industries
- OREDA has been widely accepted as the source for reliability data in the offshore industry
- OREDA data and results have been used as input in many RAMS analyses to give more confidence in results
- OREDA experience have generated a more standardized approach to defining, specifying and utilizing reliability knowhow in the offshore industry.
- OREDA knowhow has been widely used in development of the international standards ISO 14 224 and ISO 20815.
- 28 years (2009) of joint industry co-operation has shown that is it possible to work for a common goal across differences in company philosophy, language, culture, distance etc.

