Potential for Acid Gas Injection at Kharg Island

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Potential for Acid Gas Injection at Kharg Island

- Gas Liquids Engineering Ltd.
- Iranian Offshore Oil Company
- John Brown Hydrocarbons
- Hycal Energy Research Laboratories
- Fekete Associates Inc
- Tehran Energy Consultants
- Shell Global Solutions

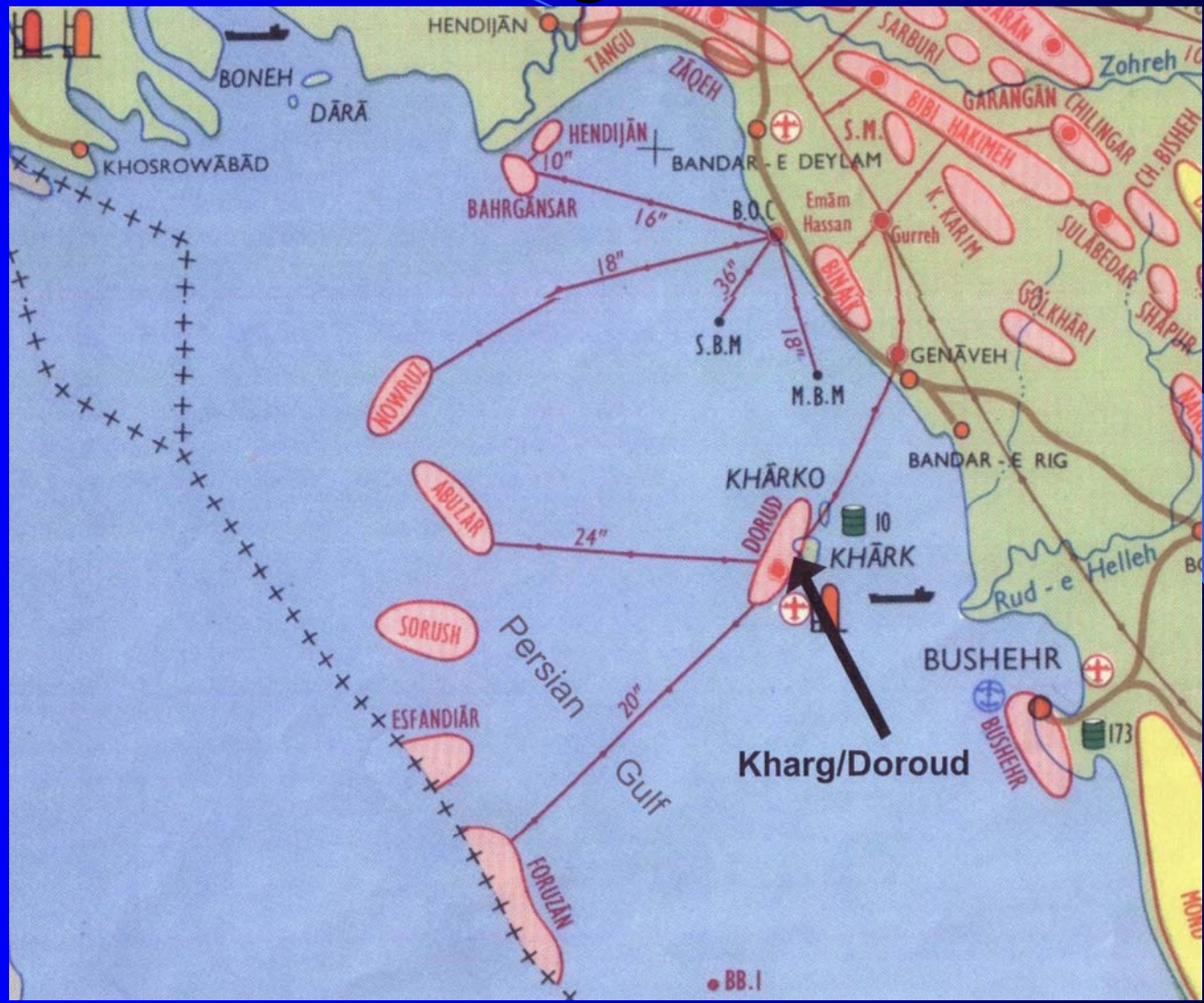
Potential for Acid Gas Injection at Kharg Island

- 2002: FEED of entire facility with sulphur plant
- 2003 Conceptual design of AGI
- 2004 Core obtained from injection well
- 2004 Core and reservoir studies underway
- 2004 AGI FEED underway
- 2005 AGI FEED completion

Kharg Island

Operators AGI – SOGAT 2004

Kharg Island



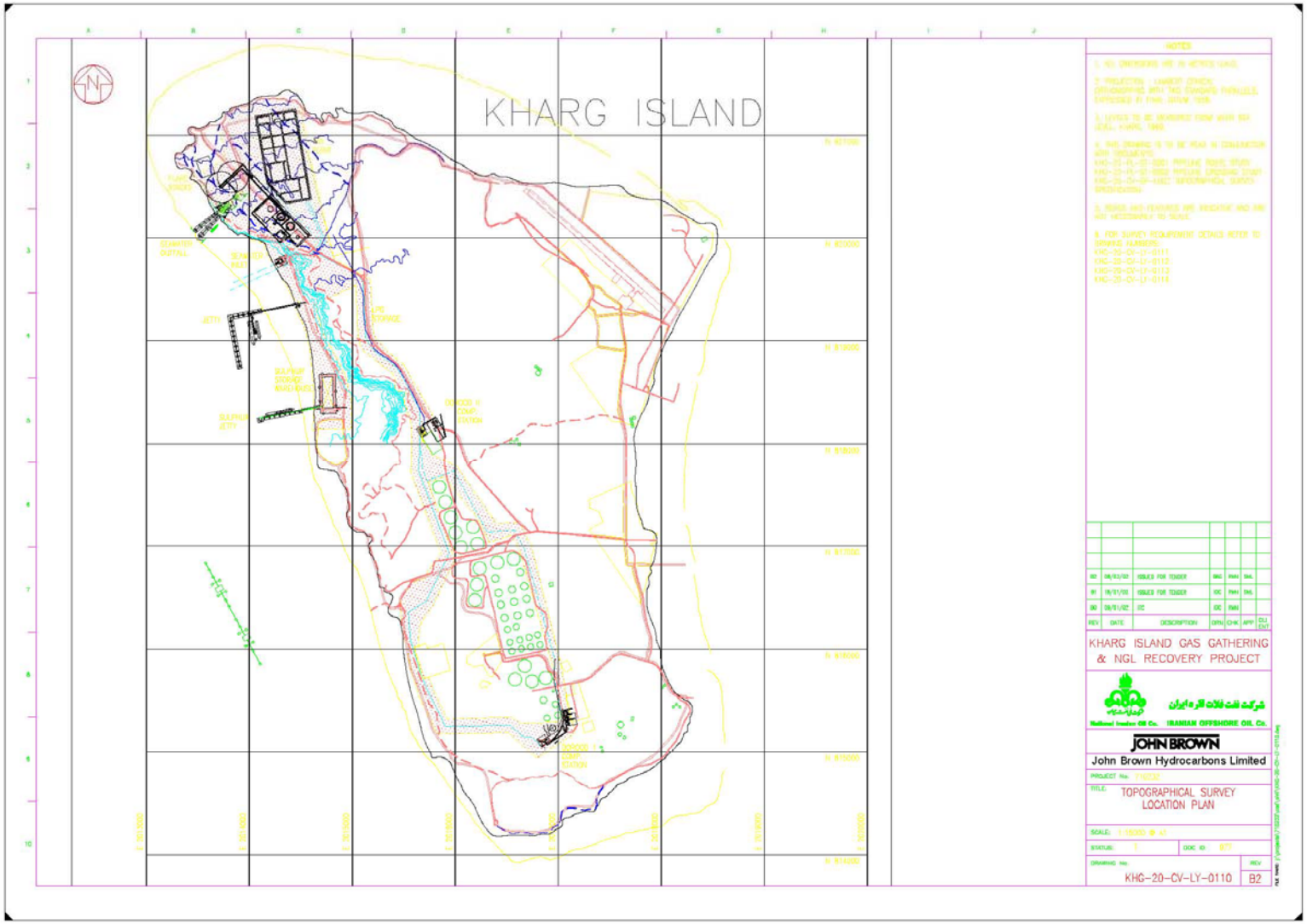
Kharg Island Project

- Two separate gas treatment and NGL plants.
- On shore gas from existing and new oil facilities.
- Offshore gas from new oil facilities.
- Raw gas feed stream of 600 MMscfd.
- Ethane, propane, butane, pentane products.

Kharg Island Project

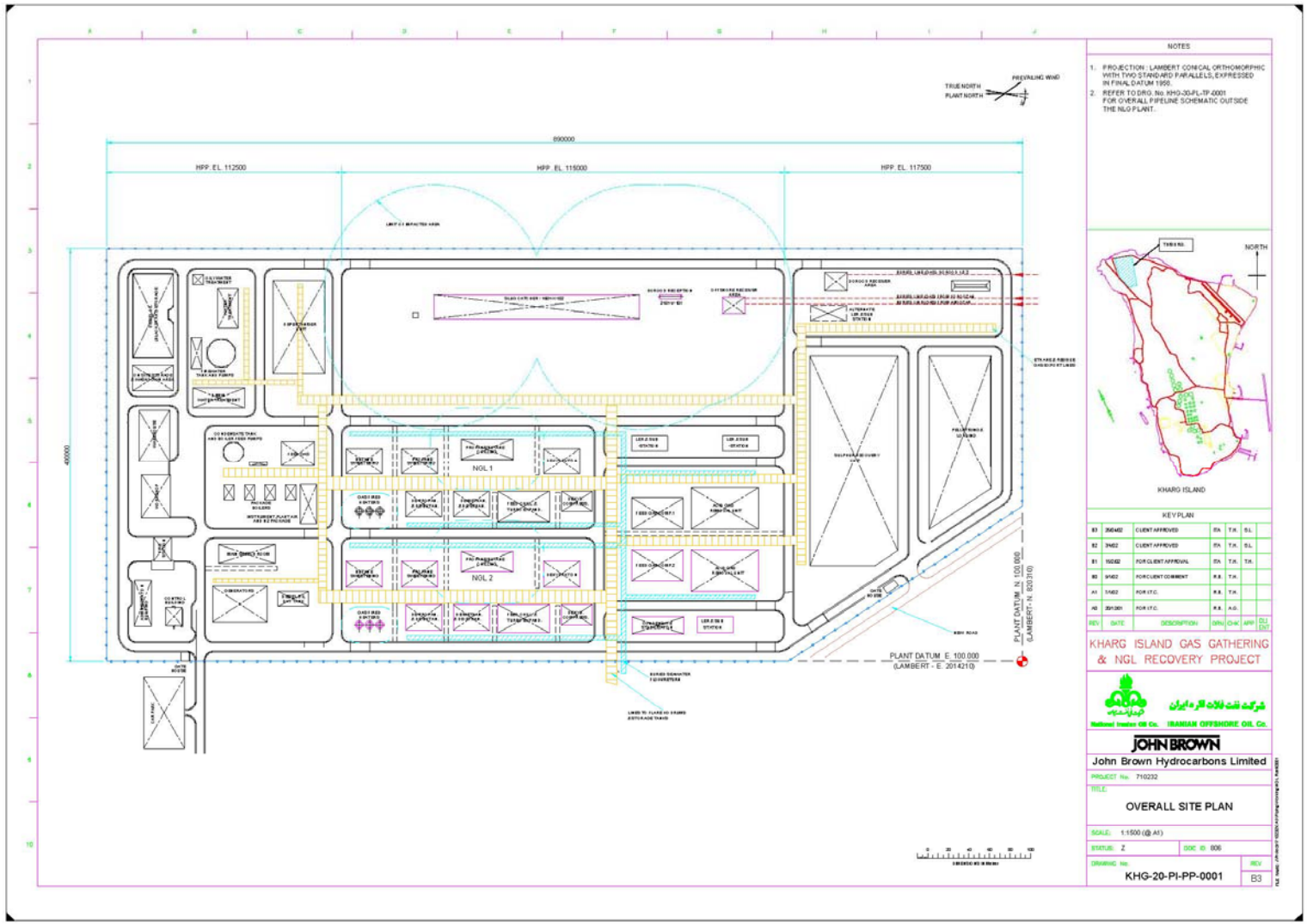
- Two separate acid gas removal units have been designed by Shell Global Solutions.
- Original FEED included a 1,200 t/d sulphur plant.
- Current AGI FEED to inject 85 MMscfd of acid gas.

Kharg Island



Operators AGI – SOGAT 2004

Kharg Island



Operators AGI – SOGAT 2004

Kharg Island Injection Reservoir

- Adequate reservoir size for acid gas volume
- Caprock integrity
- Required injection pressure will not cause fractures
- No interaction with existing or future wells
- Seismic risk
- Injection requirements are obtainable

Kharg Island Injection Reservoir

- Formation should accessible from Kharg Island
- No risk of communication with production wells – injection zone must be below current and future production

Kharg Island Dhruma Formation

- D-21 core & DST data obtained. Additional log and seismic data from area.
- Depth: 4016-4150 m
- Net pay: ~125 m
- Porosity: 15-23%
- Permeability: 10-600 mD
- Formation: 417 bara, 121 deg C

Kharg Island Dhruma Formation

Kharg Island Dhruma Formation

- Hycal: Core evaluation, core flooding studies, core description, caprock evaluation.
- Fekete: Formation evaluation, reservoir modeling and simulation, wellbore modeling.
- GLE: Well bore modeling.

Kharg Island Reservoir Injectivity

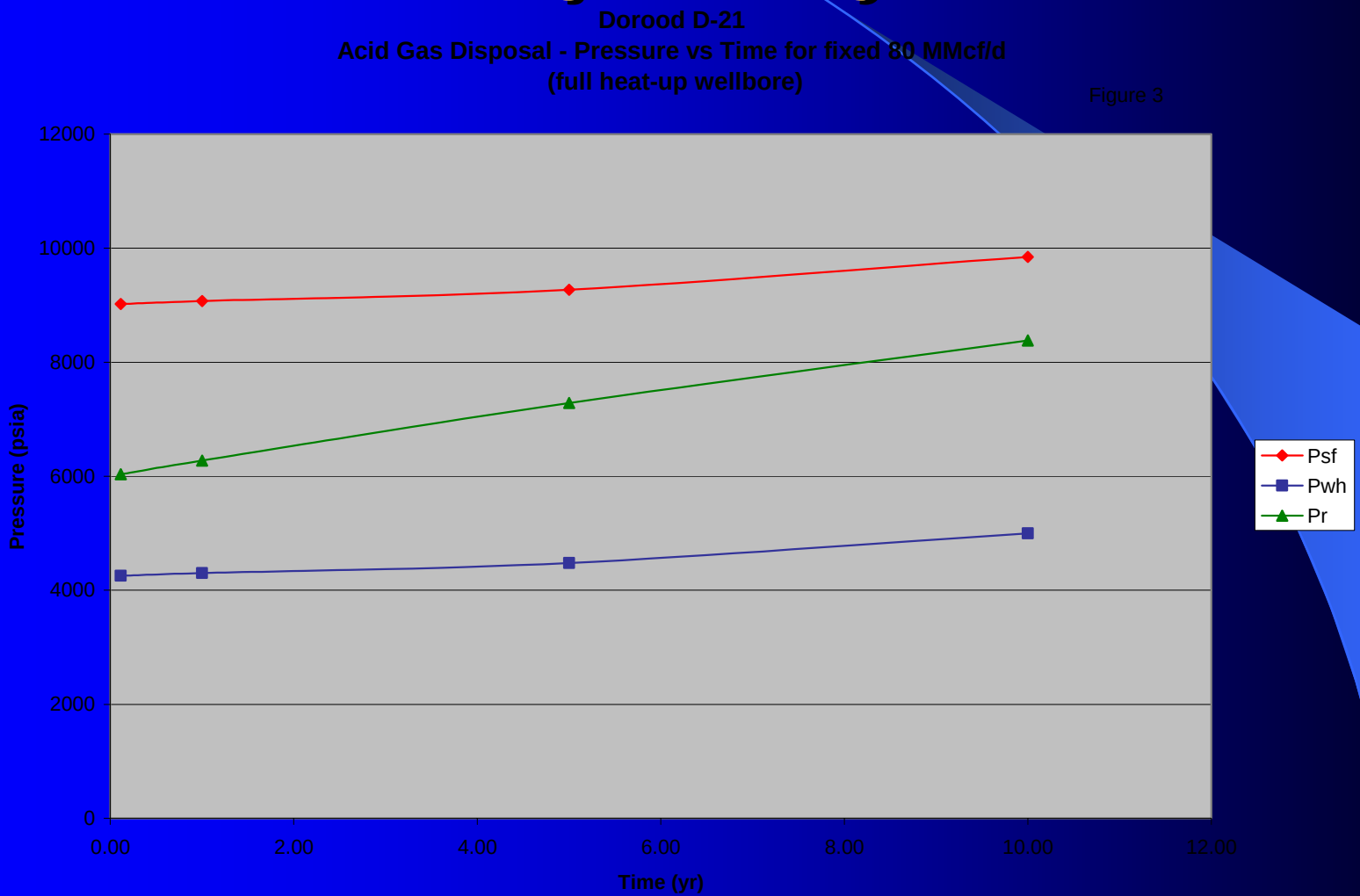
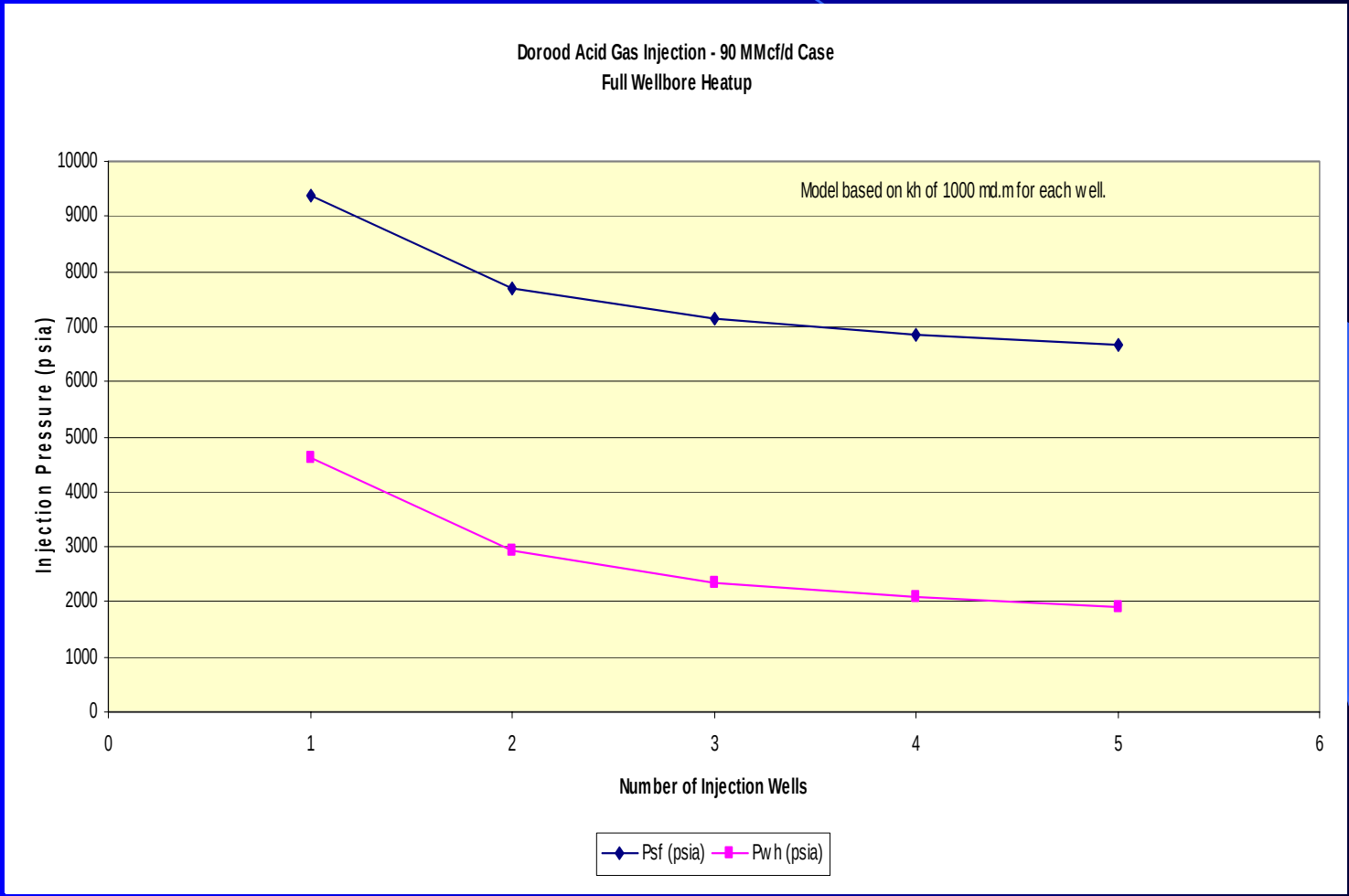


Figure 3

Kharg Island Reservoir Injectivity



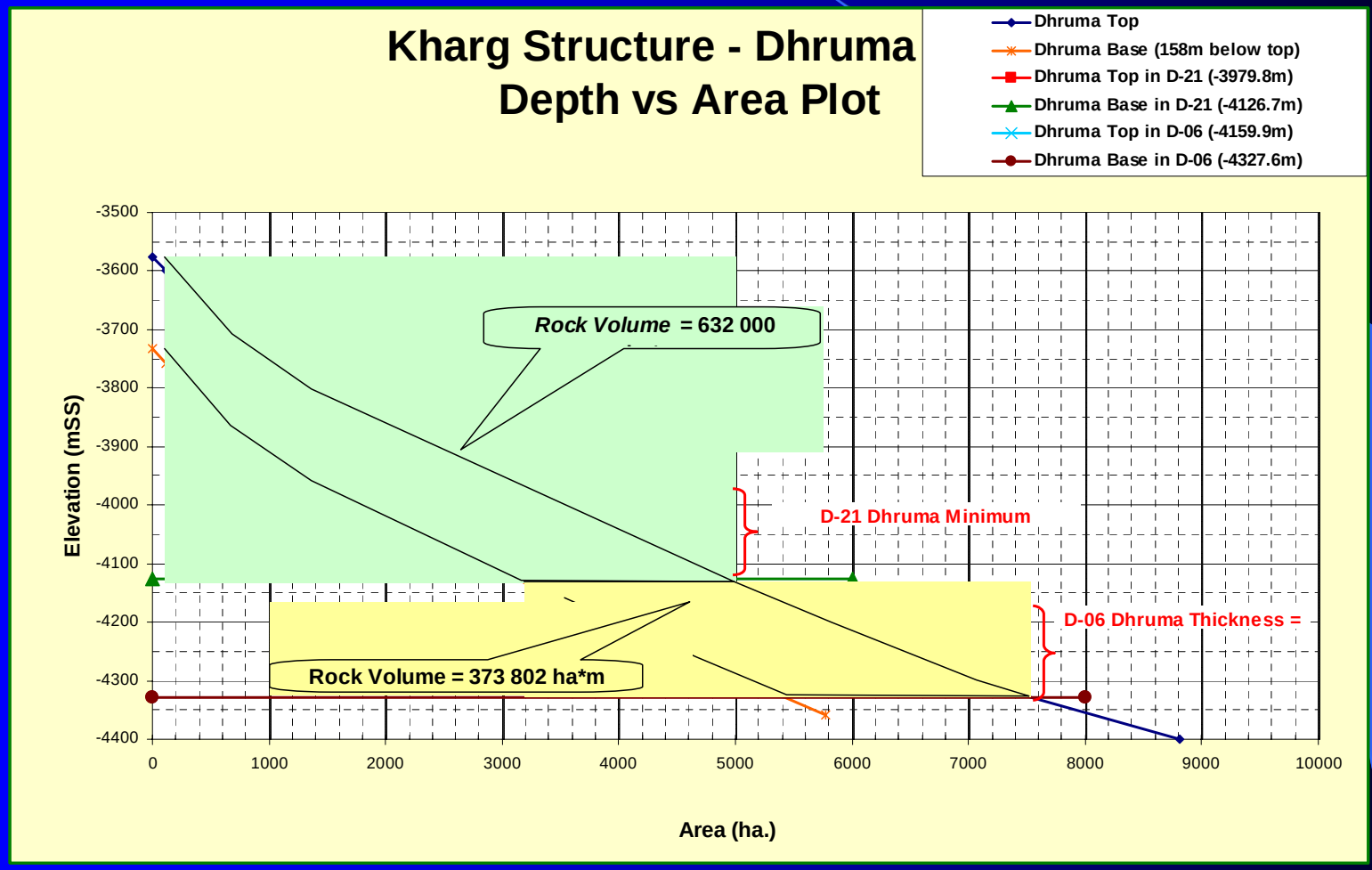
Kharg Island Reservoir Injectivity

- Preliminary forecast: Sandface injection pressure of 622 bara. Wellhead pressure of 275-345 bara.
- Interim forecast: 165 bara wellhead pressure if injection stream of 90 MMscfd split to three well.
- Additional modeling underway.

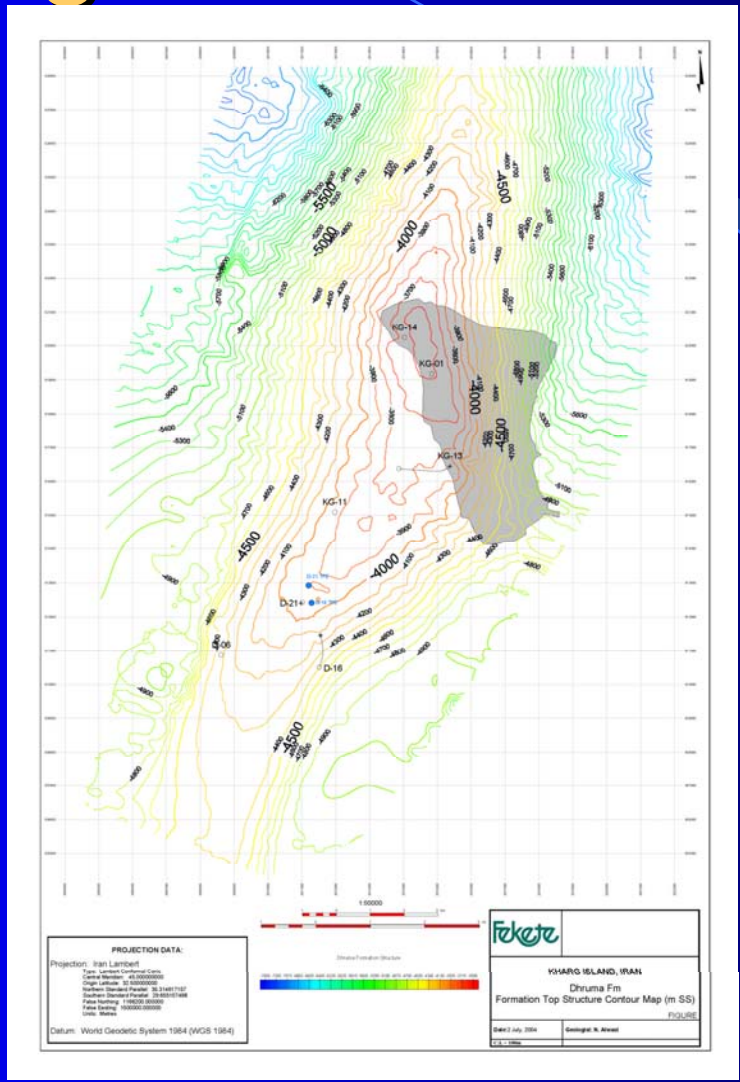
Kharg Island Reservoir Capacity

- Cumulative injection of 394 Bscf (about 12 years) ideally occupies a rock volume of 2700 ha.m
- Dhruma rock volume exceed 632 000 ha.m

Kharg Island Reservoir Capacity



Kharg Island Reservoir



Operators AGI – SOGAT 2004

Kharg Island Injection Reservoir

- Awaiting caprock analysis and additional reservoir injection simulation.
- Finalize injection well design.
- Finalize required wellhead pressure.

Kharg Island AGI Facilities

- Awaiting caprock analysis and additional reservoir injection simulation.
- Finalize injection well design.
- Finalize required wellhead pressure.

- Design pipeline
- Design acid gas compression

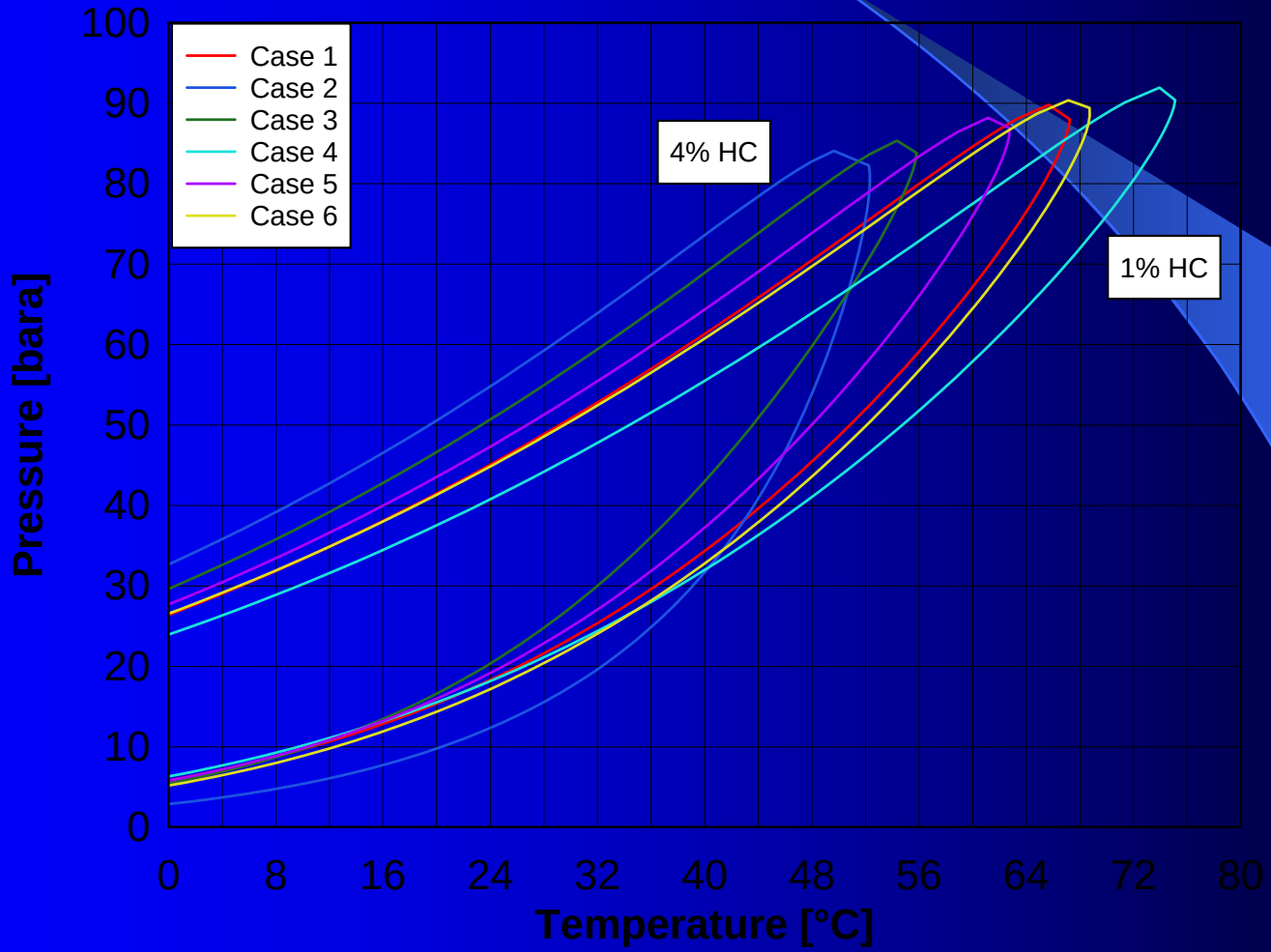
Kharg Island AGI Feed

- Design from reservoir data not currently possible
- Discharge pressure set at 180 bara
- Preliminary design indicates 165 bara required for injection into three vertical wells.

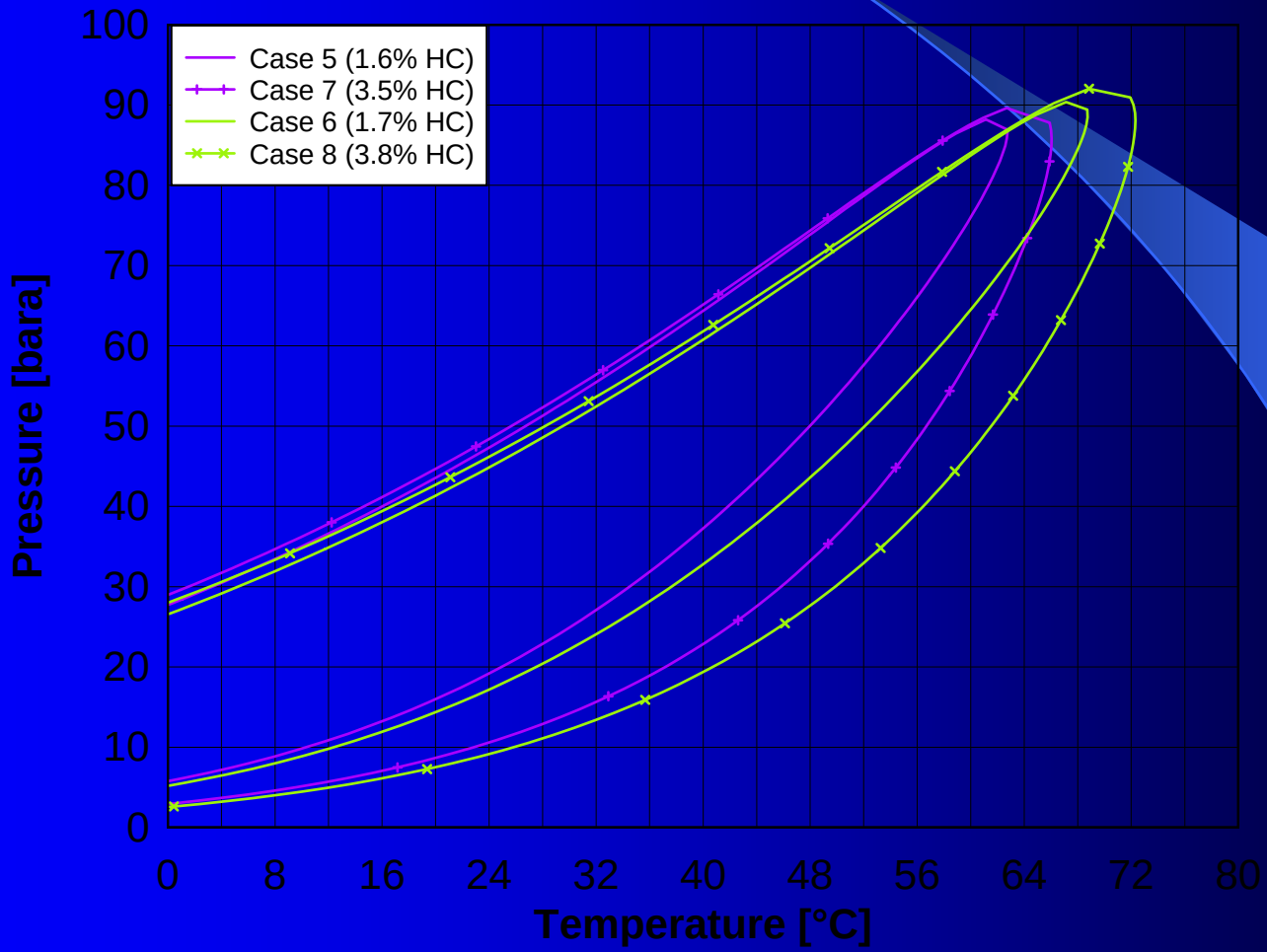
Kharg Island AGI Feed

- Maximum: 85.8 MMscfd
- Minimum: 18 MMscfd
- 1.7 bara at 45 deg C
- 33-64 mol % H_2S
- 29-57 mol % CO_2
- 0.3-1.3 mol % CH_4
- 0.5-2.2 mol % C_{2+}

Kharg Island AGI Phase Envelope



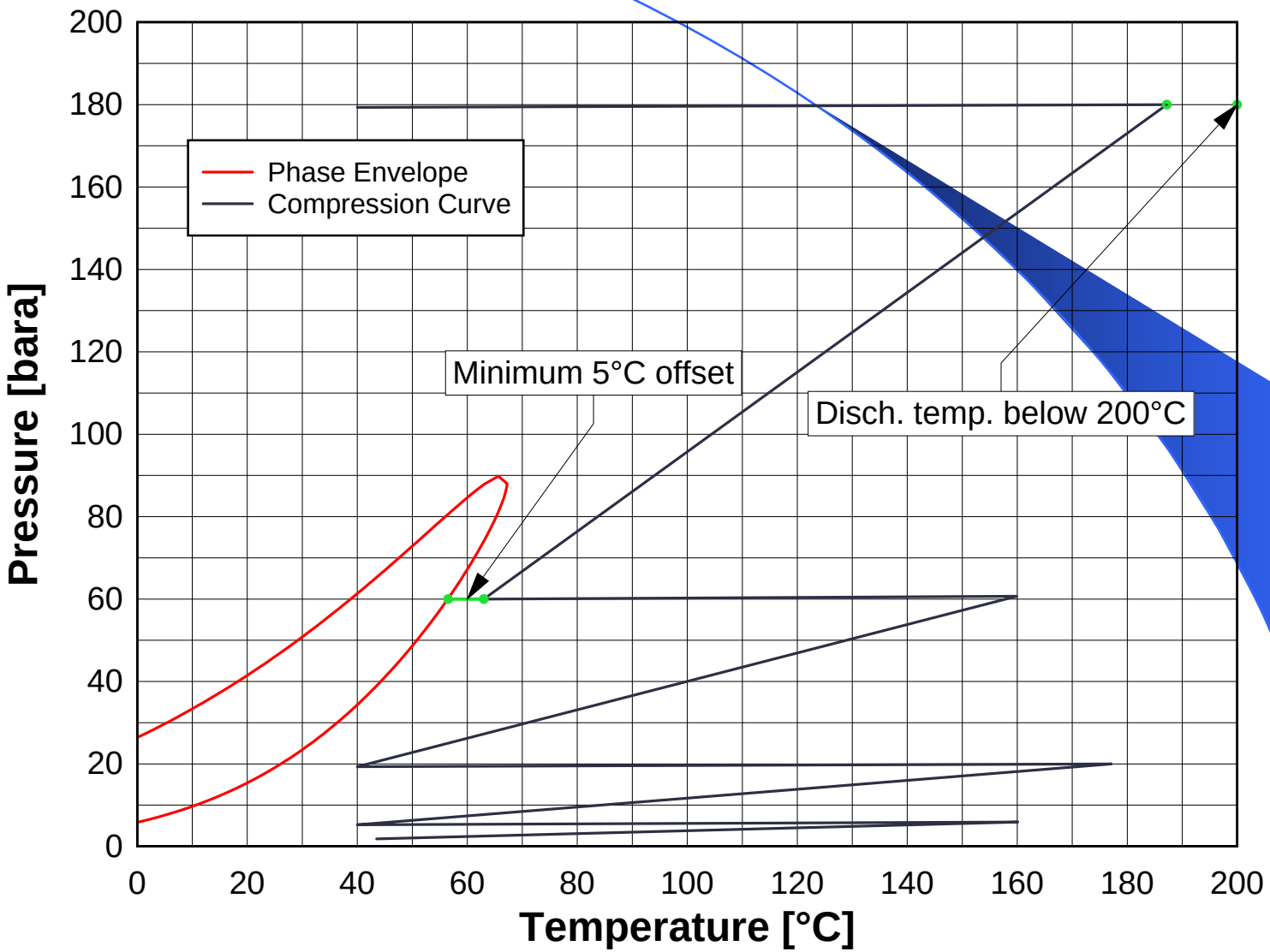
Kharg Island AGI Phase Envelope



Kharg Island AGI Compression

- Pressure – suction 1.7 bara, discharge 180 bara
- Maximum interstage temperature: 180-200 deg C
- Interstage pressure/temperature to avoid phase envelope by a minimum 5 deg C
- Interstage conditions to maximize dehydration

Kharg Island AGI Compression



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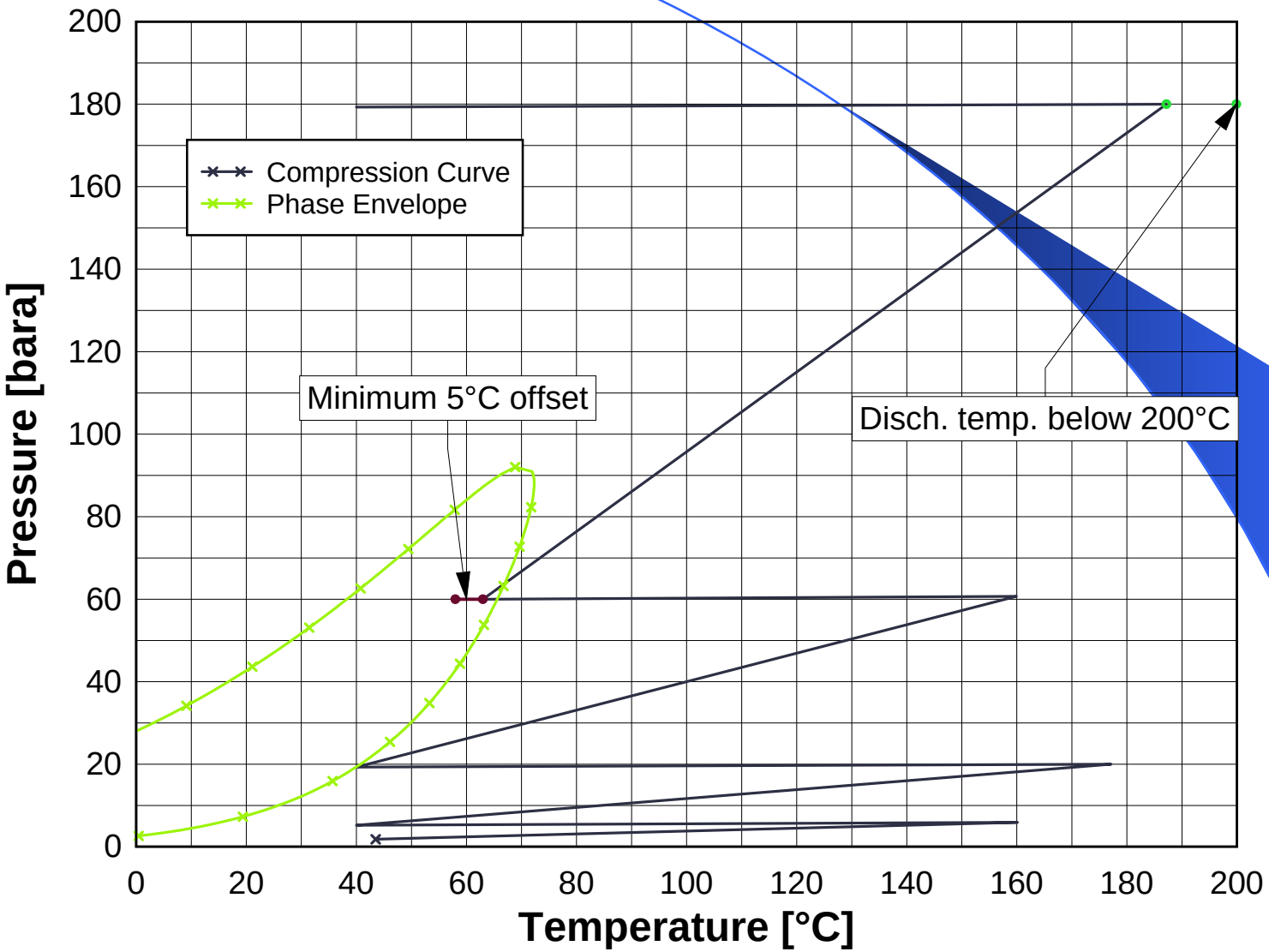
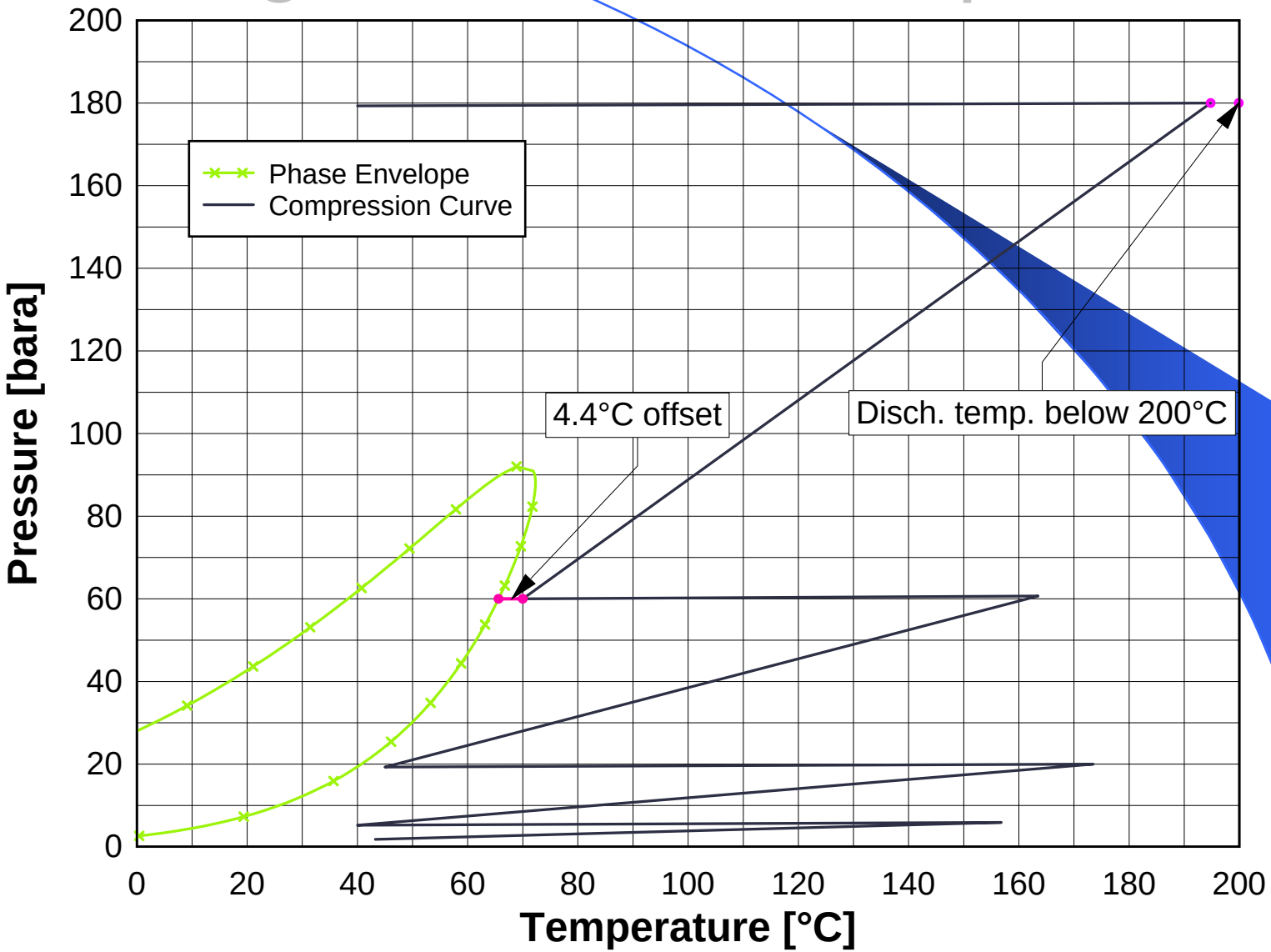
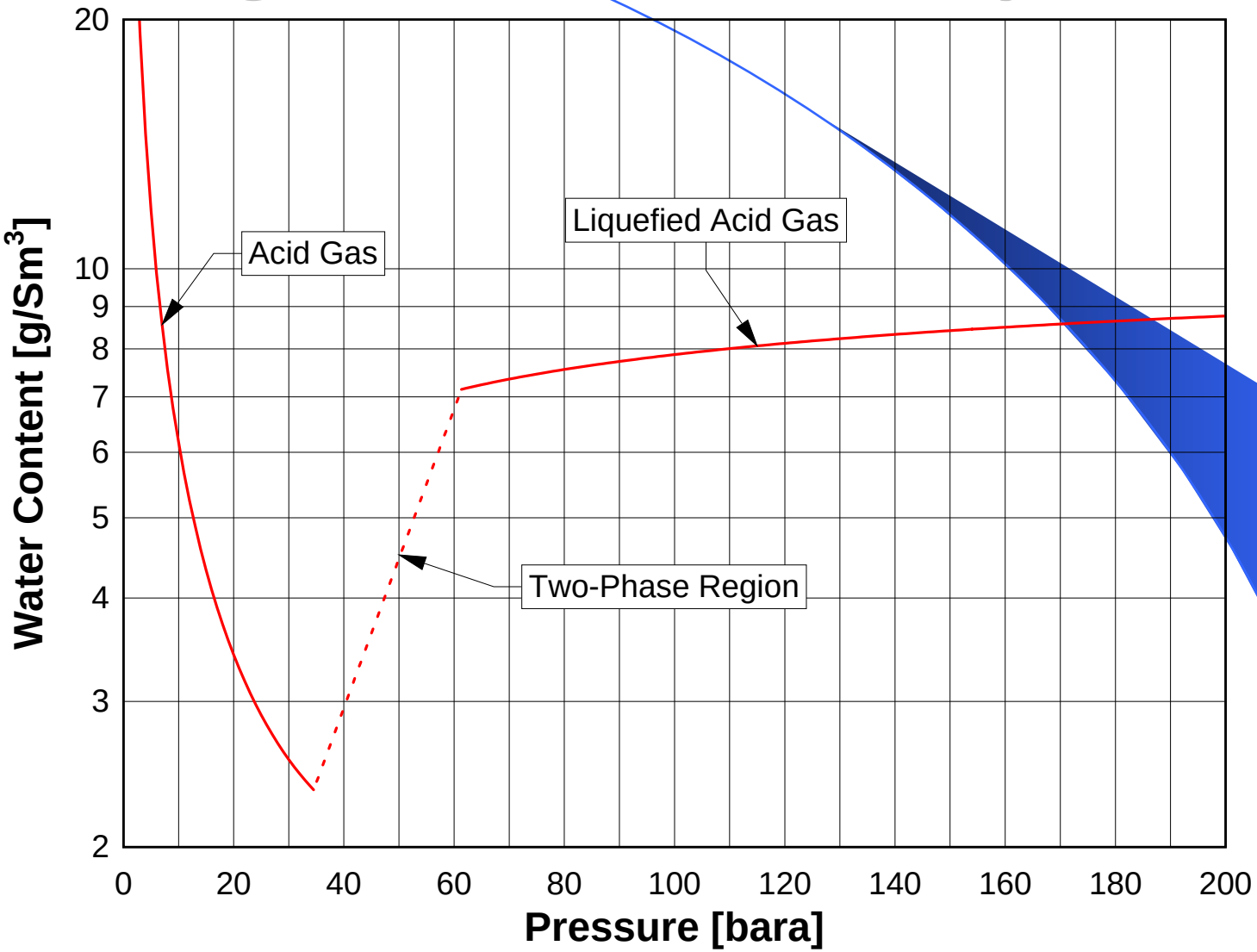


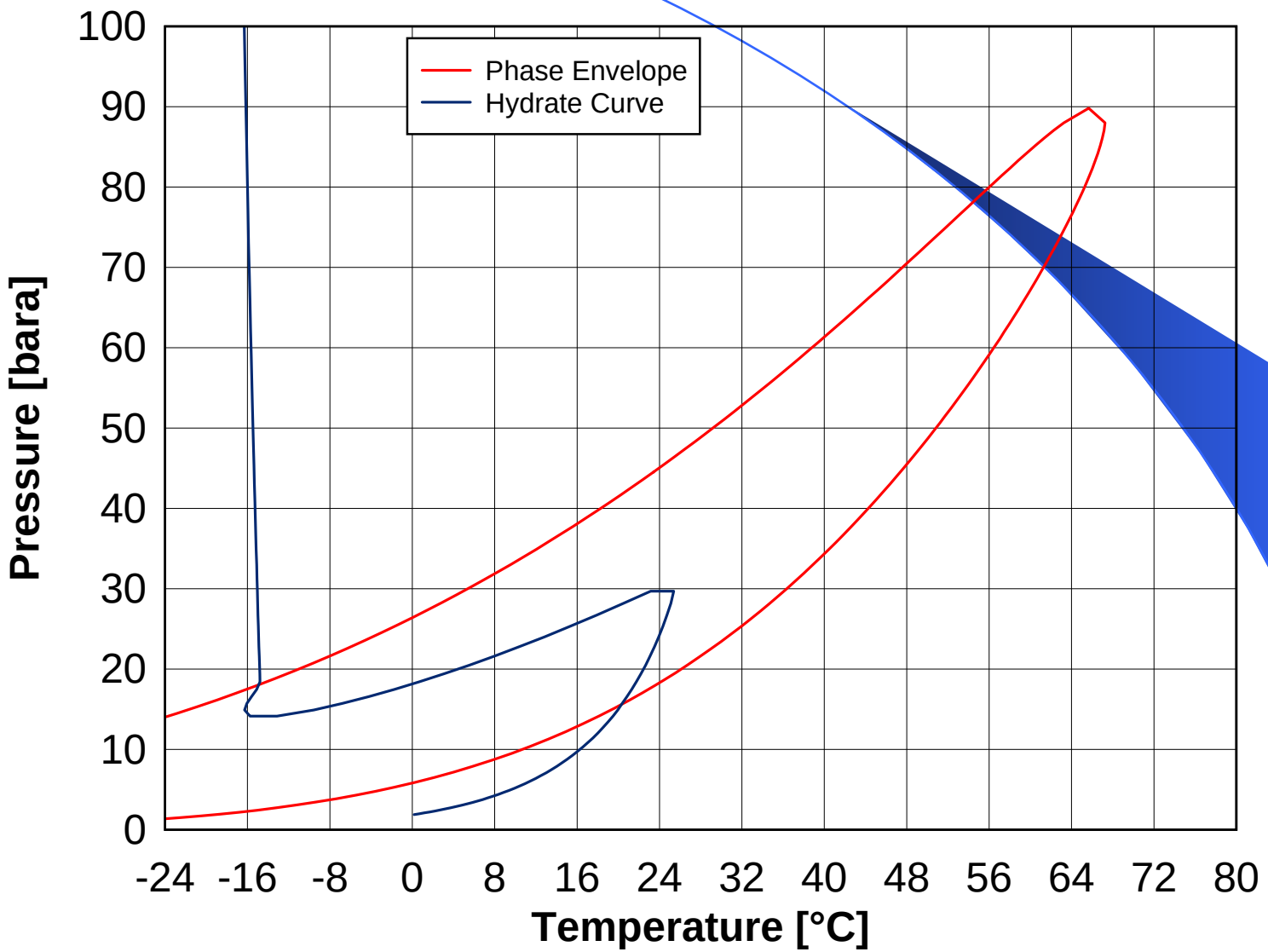
Kharg Island AGI Compression



Kharg Island AGI Dehydration



Kharg Island AGI Hydrates



Kharg Island AGI Compression

- Compression equipment must be reliable.
- 3 x 50% centrifugal, natural gas fired turbines at 11 500 kW.
- Interstage: maximize dehydration and minimize dense phase formation
- Variable rate and composition

Kharg Island AGI

- Core and reservoir studies are near completion.
- Pipeline/wellbore design will commence in January.
- AGI FEED completion in early 2005.
- Preliminary HAZOP early in 2005.

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