MULTIPHASE PUMPING

by
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Mr. Heyl has a B.S. degree (Engineering Science) from Hofstra University and attended Columbia University. He is a Steering Committee member of the API Subcommittee on Mechanical Equipment, and is Chairman of API 674, API 675, and API 676 Task Forces. He has participated on API 682, API 614, and API 682.

Written text was not submitted for this tutorial. The slide presentation is provided here.

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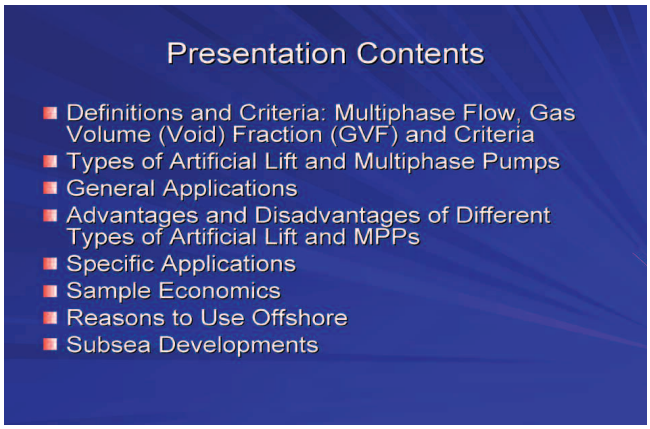

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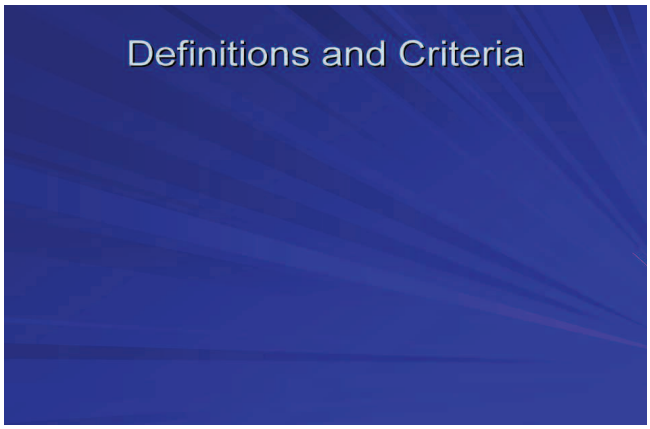

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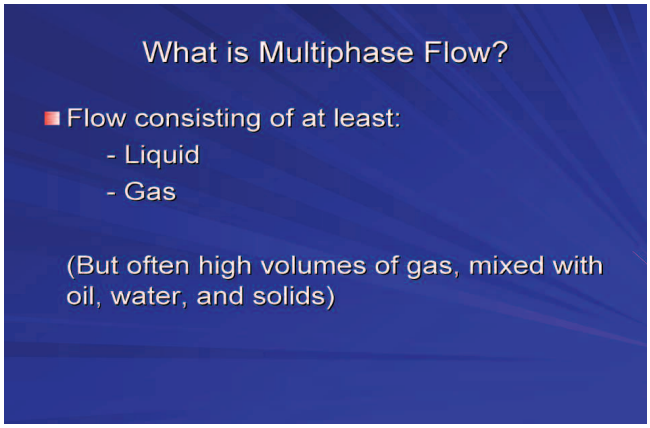

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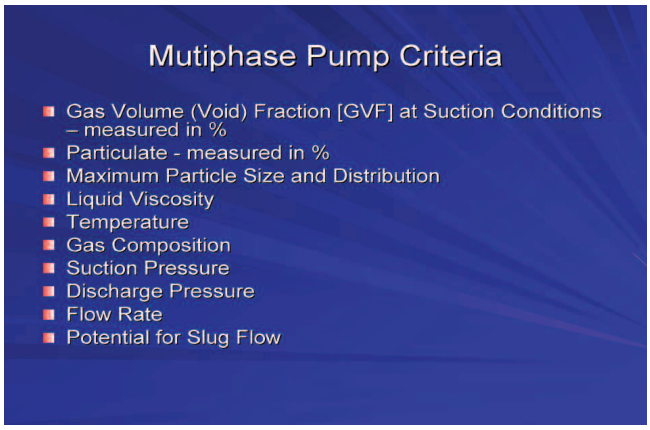

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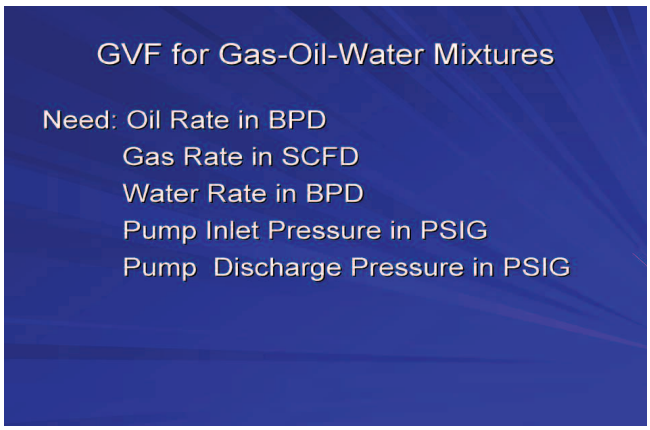

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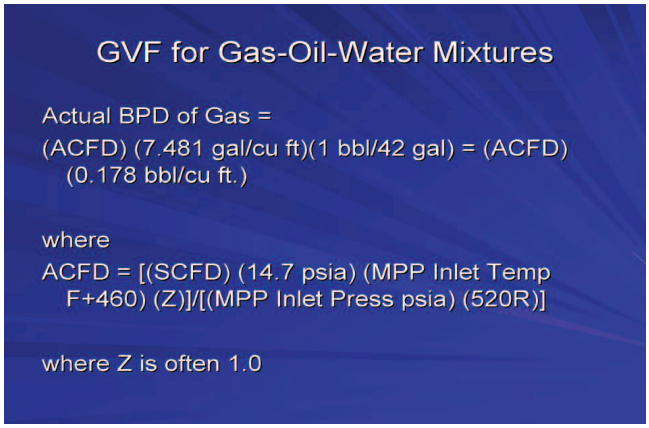

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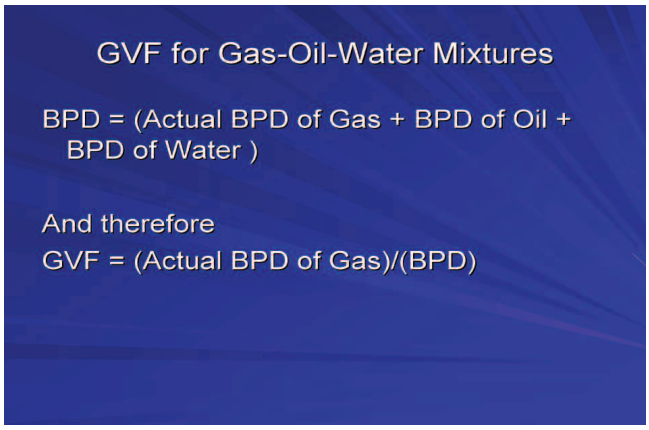

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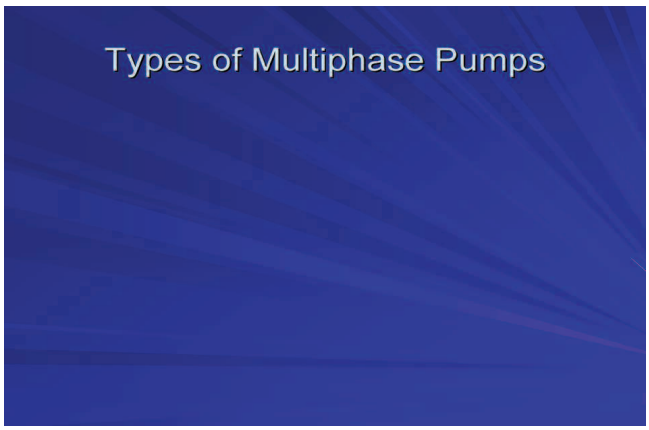

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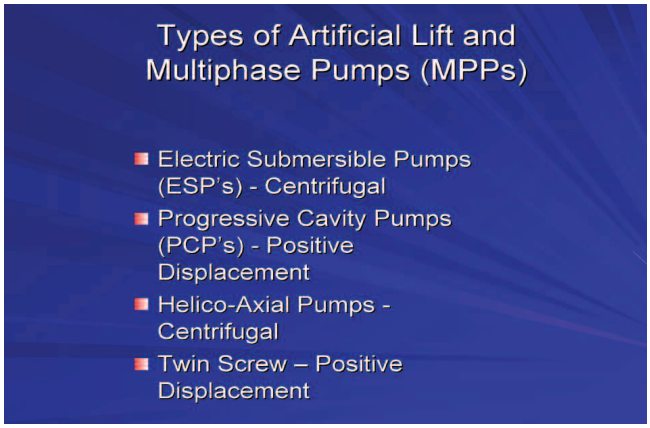

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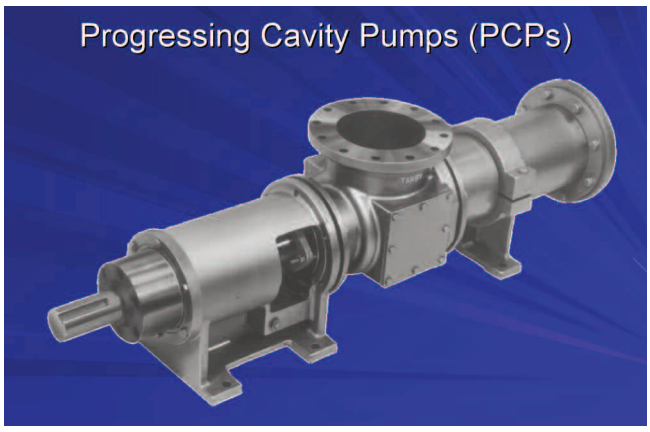

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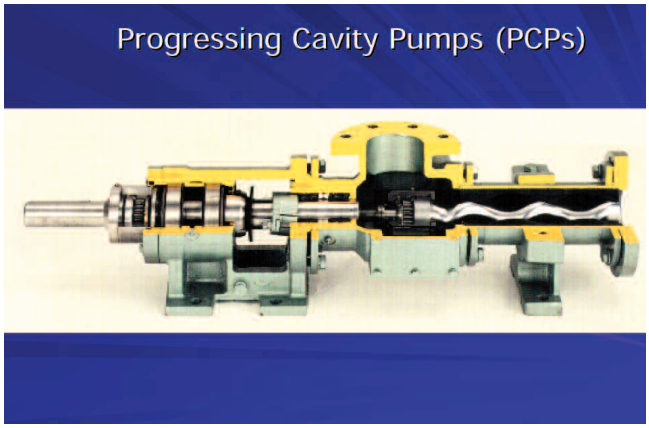

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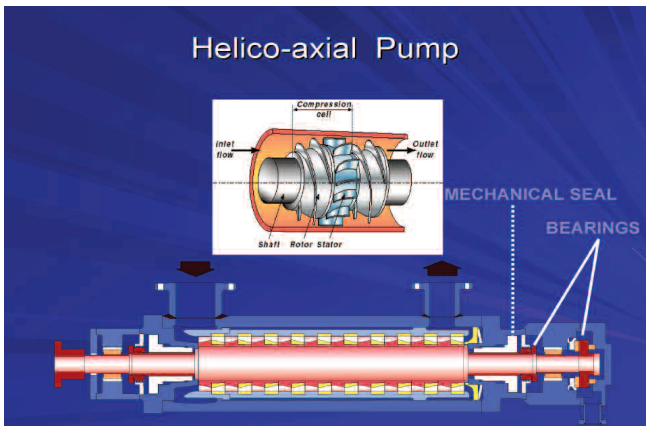

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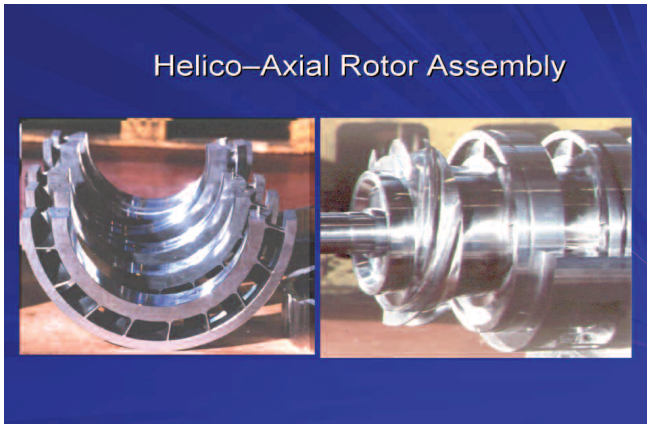

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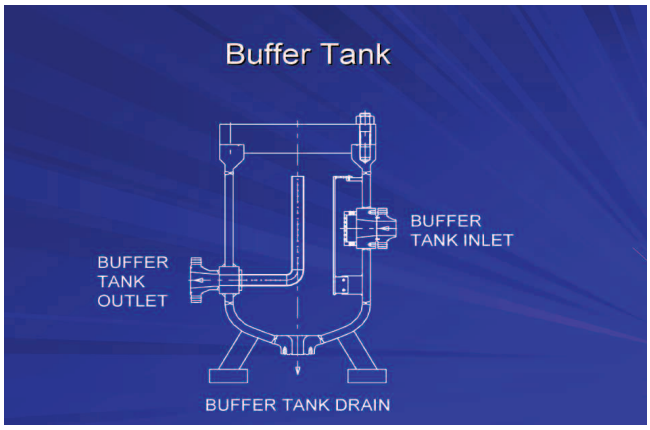

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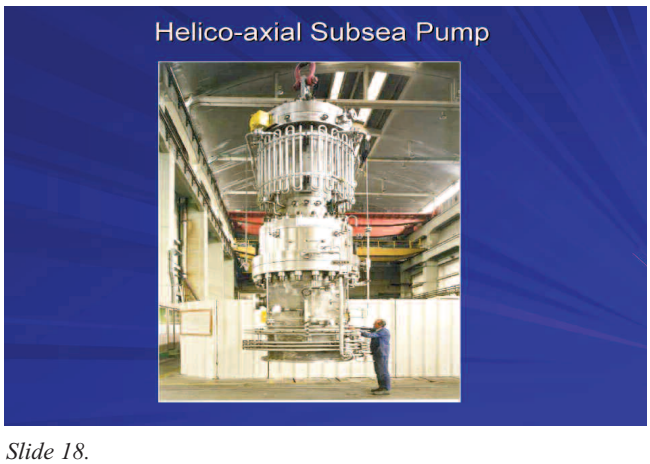

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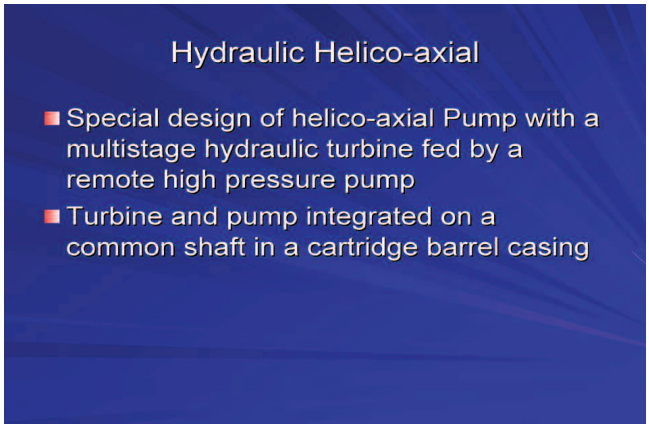

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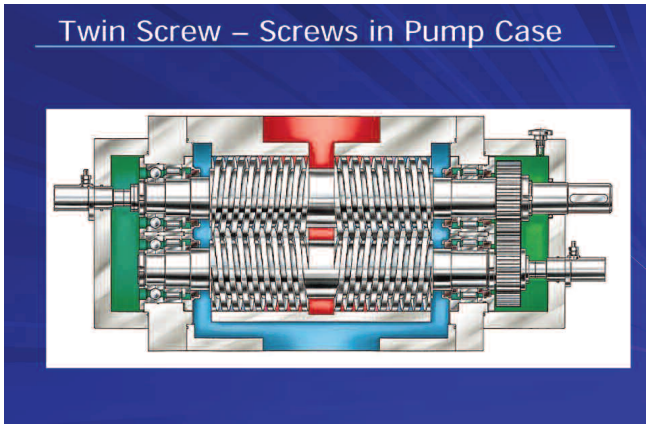

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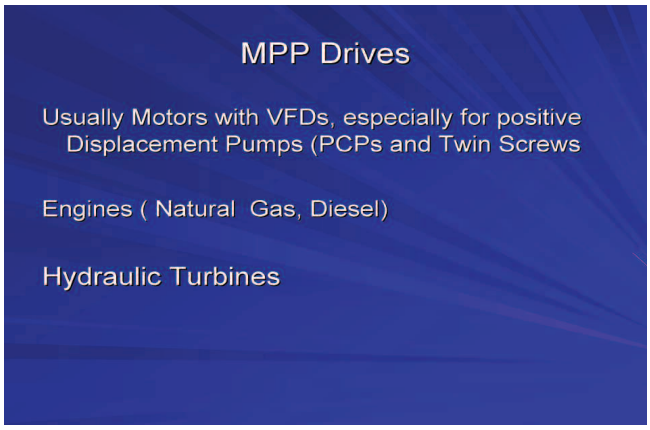

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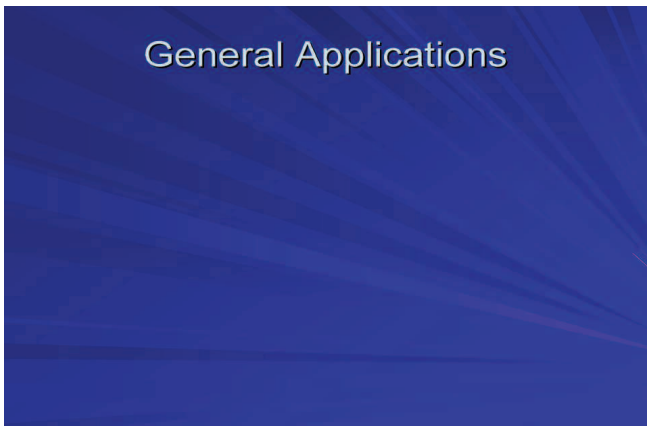

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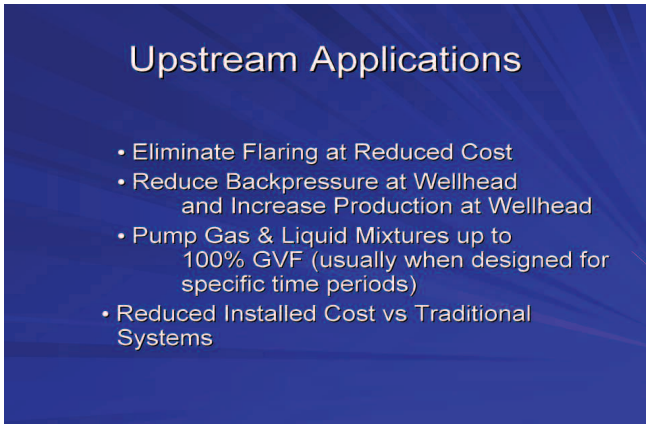

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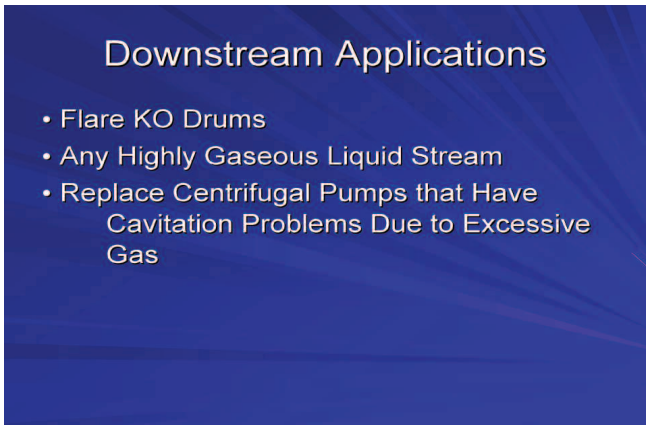

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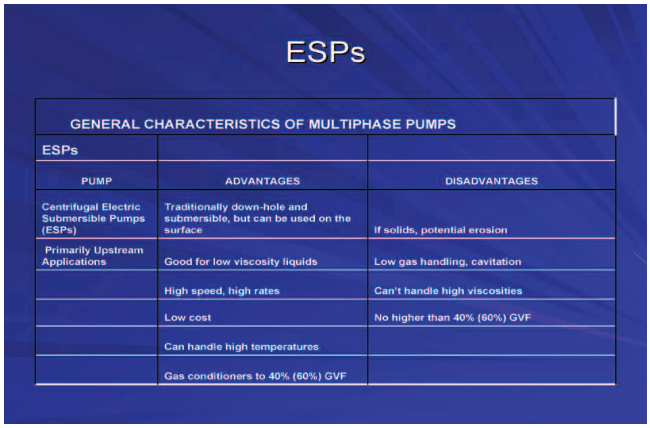

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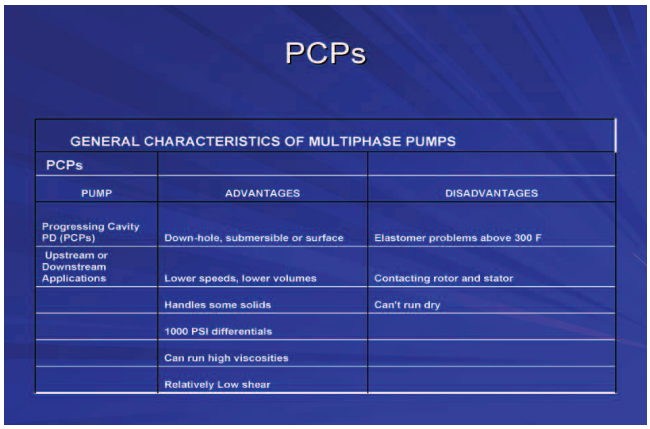

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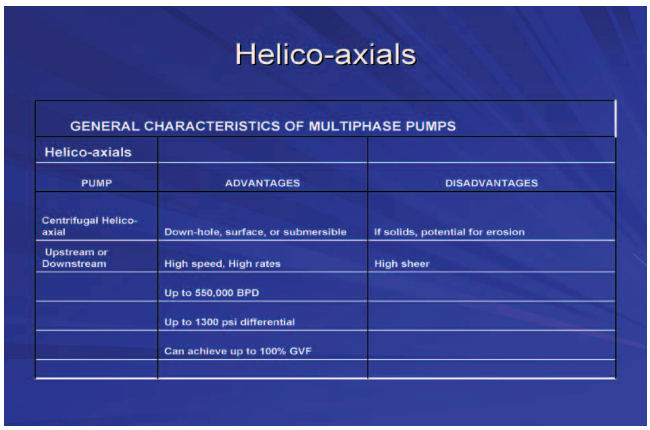

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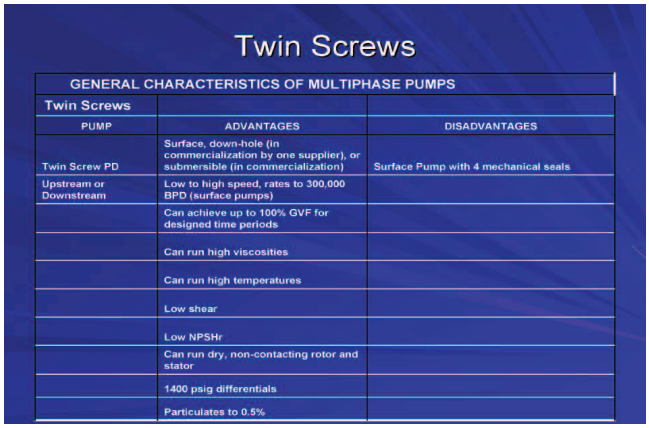

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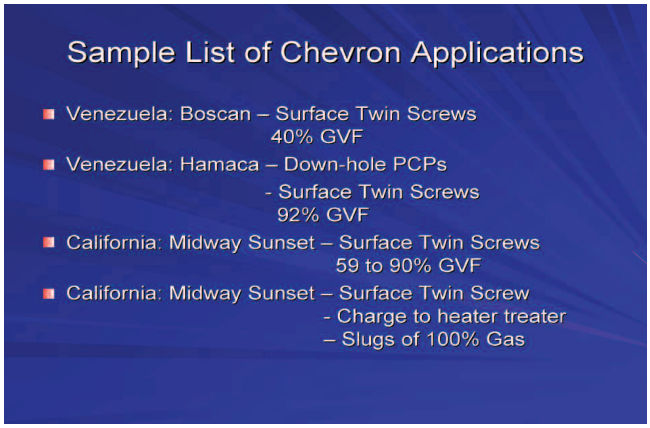

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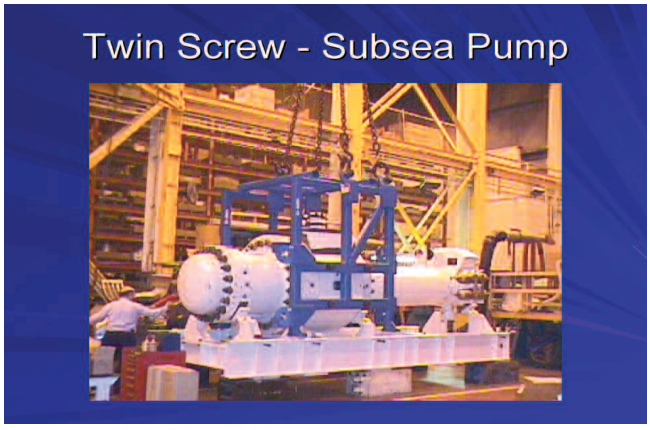

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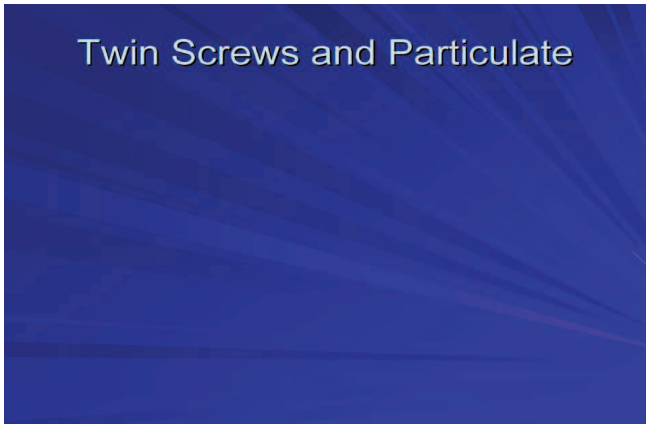

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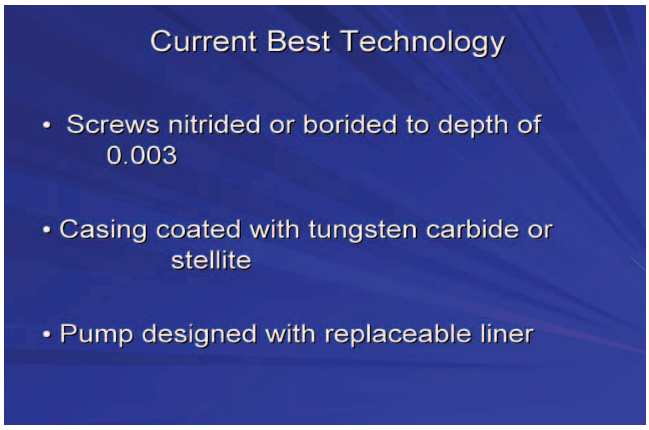

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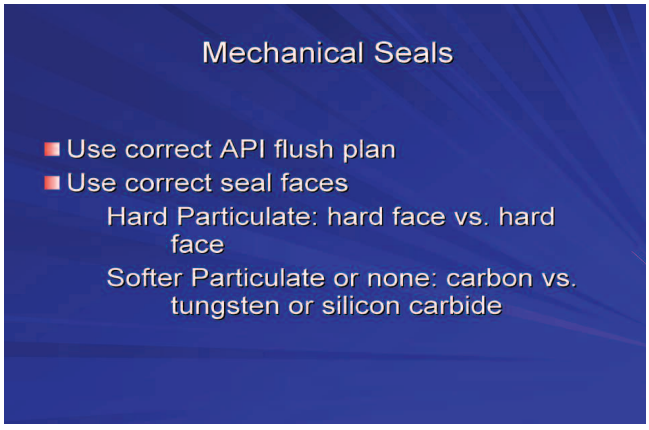

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Indonesian Experience

- Multiphase production and the installation costs of the traditional system demands simpler and smaller installation and a more cost effective production system.
- ***Twin Screw multiphase pumping application in heavy oil steam flood in sandy environment is proven to be feasible.***
- To date, operational reliability satisfies if not exceeds acceptable industrial standard.

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Sample Economics

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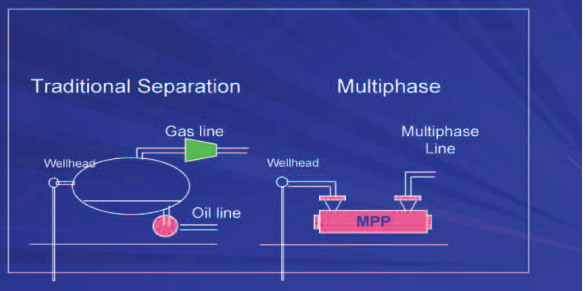
Multiphase Installation Advantages



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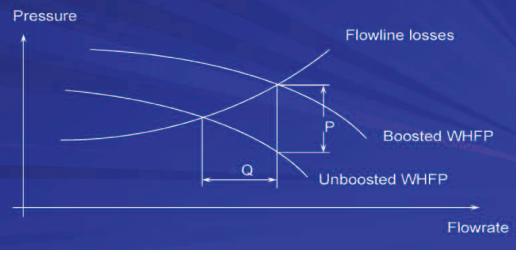
MULTIPHASE BOOSTING



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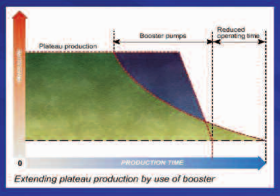
Typical Production Increases



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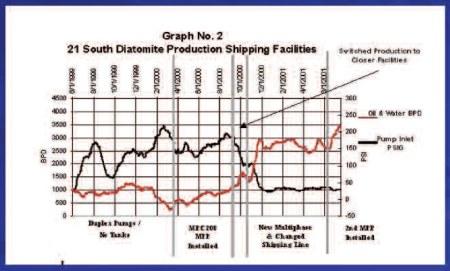
Production Increase Due to Reduced Backpressure on Wells



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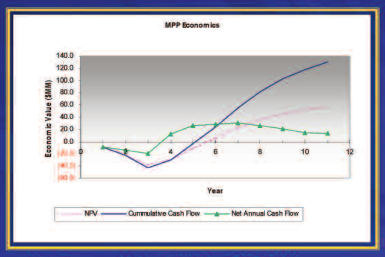
Economics, MPP Case



Net Present Value (NPV) = $56.5 MM
Discounted Profitability Index (DPI) = 1.66
Internal Rate of Return = 36.0%
Payback = 5.1 years

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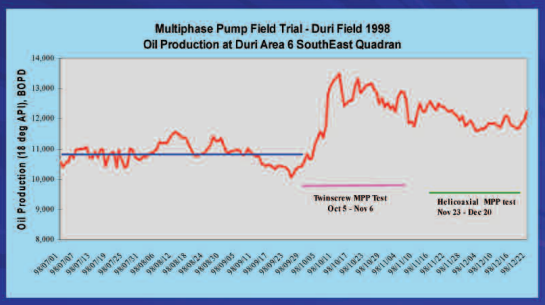
Duri Production Increases with MPPs



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Offshore Economics Example

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Reasons to Use MPPs Offshore (or Onshore)

- No need to have separation vessel
- One MPP vs. liquid pump and gas compressor
- Smaller installed footprint (especially for offshore rigs)
- Less weight (especially for offshore rigs)
- One COMBINED liquid/gas line (especially for offshore rigs and Subsea installations)

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Escravos 3B Project: MPP Process

- The Team narrowed MPP down to four platforms for investigation…Malu, Opolo, Ewan & Isan
- Sought technical support from Chevron ETC, other SBU experiences
- Preliminary GVF ranged from Opolo (81%) to Isan (97.2%). Opolo and Malu (95%) were considered positive based on CVX field experience.
- Received technical proposals from Bornemann and Leistritz
- Revised Gas forecast…May 2004 gives GVF above 98%

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Escravos Economics

- Opolo - Potential capex savings would be about $6MM.

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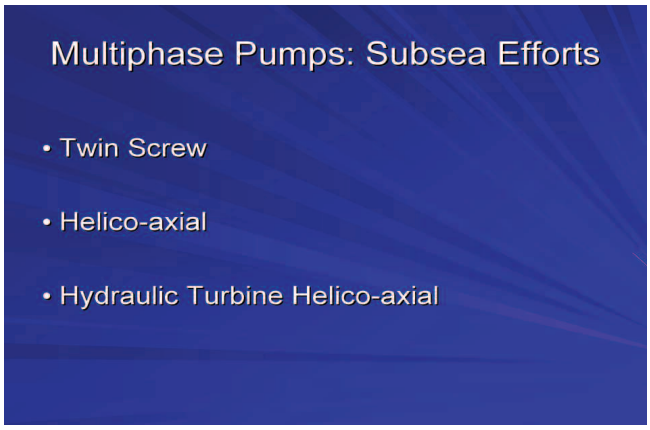

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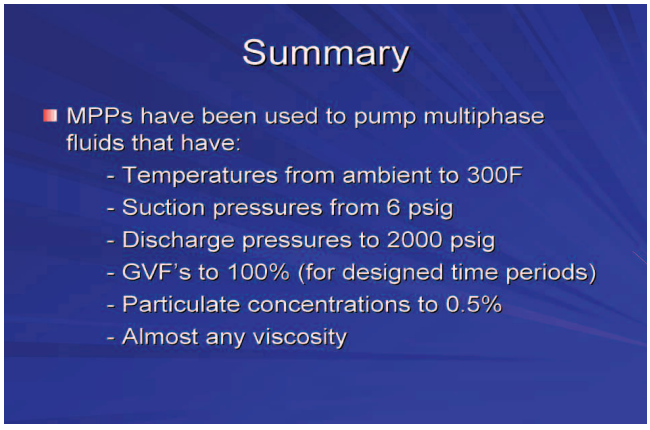

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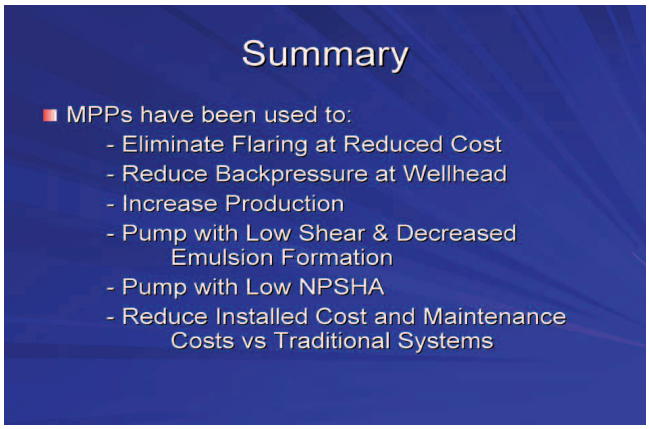

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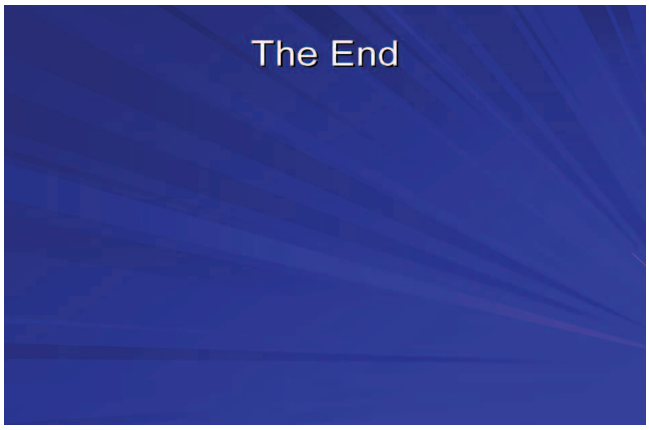

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