



FLOW ASSURANCE CHALLENGE

“Multiphase Flow in Pipes”

Discussion Leader – Jim Brill

Schedule



- **Opening remarks – Jim Brill (15 min)**
- **Discussion – Audience (45 min)**
 - **2-3 slides each speaker**
 - **5 min. limit for each speaker**
- **Breakout Session (3:00 – 4:00 PM)**

Multiphase Flow in Pipes



- **Marvelous technology growth – 25+ years**
 - **Many Research Consortia/JIPs**
 - **Sophisticated Experimental Facilities**
 - **High Tech Mechanistic/Unified Models**
- **Fantastic Software Development**
 - **Transient**
 - **Steady State**
 - **Production Analysis**

Multiphase Flow in Pipes ...



- **Deep Water Challenges Due To:**
 - **Low Temperatures**
 - **High Pressures**
 - **Long Distances**
 - **Hostile Climates**
 - **Very Expensive Operations**

Multiphase Flow in Pipes ...



- **Some Lagging Technologies**
 - **Heavy Oil and Effect of Water**
 - **Low Liquid Holdup**
 - **Mechanistic/Unified Heat Transfer Models**
 - **Paraffin Deposition**
 - **Hydrate Transport**
 - **Chemicals/Distribution**

Heavy Oil and Effect of Water



- **Fluid Properties**
 - **Viscosity**
 - **Mass transfer**
 - **Emulsions, dispersions, inversion, separation**
- **Flow Behavior**
 - **Flow patterns**
 - **Pressure drop**
 - **Effect of inclination**

Low Liquid Holdup



- **Poorly predicted by current models**
 - **Magnitude**
 - **effect on pressure drop**
 - **Effect on hydrates, paraffin deposition, corrosion, ---**

Heat Transfer Models



- **Deep water operations require good heat transfer predictions**
- **Multiphase flow heat transfer (temperature change) is many years behind momentum transfer (pressure change)**

Paraffin Deposition and Hydrates



- **Thermodynamics quite well understood**
- **Multiphase flow effects still inadequate**
 - **Effect of water on paraffin deposition**
 - **Modeling flow behavior of hydrates**

Chemicals



- **Chemicals for controlling corrosion, hydrate and paraffin formation, ...**
 - **Must be linked to multiphase flow models**
 - **Critical to get chemicals where needed**