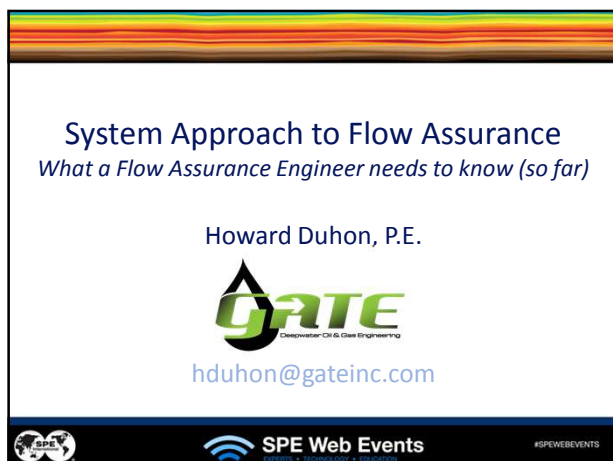
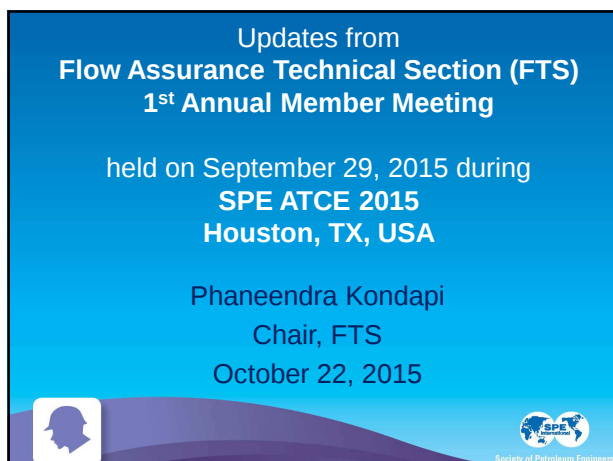








Purpose

The purpose of SPE FTS shall be to further the objectives of the Society in the open discussion of matters relating to flow assurance, to generate awareness on industry best practices, and to promote those practices widely.



Society of Petroleum Engineers

FTS Founding Leadership - 2014

Founding Chair: Dendy Sloan, Colorado School of Mines
 Chair: Jeff Creek, Chevron ETC
 First Vice-Chair: Phaneendra Kondapi, KBR-Granherne
 Second Vice-Chair: Steve Cochran, Chevron ETC
 Secretary: Hari Subramani, Chevron ETC
 Treasurer: John Nighswander, Schlumberger
 Technical Moderator: Taras Makogon, ConocoPhillips
 Director Position No. 1: Greg Hatton, Shell
 Director Position No. 2: Cem Sarica, Tulsa University
 Director Position No. 3: Scott Bufton, Universal Pegasus Intl.



Society of Petroleum Engineers

2014 Activities

Lunch-talk Programs - 2014

- | | |
|------------------------------------|--------|
| 1. Lynn Frostman, Baker Hughes | 18-Mar |
| 2. Doreen Chin, Shell | 15-Apr |
| 3. Randy Wester, FMC Technologies | 20-May |
| 4. Sam Kashou, Chevron | 17-Jun |
| 5. Walter Chapman, Rice University | 16-Sep |
| 6. Fred Felten, Halliburton | 30-Oct |
| 7. Mike Zaldivar, Evoleap | 20-Nov |

SPE ATCE, Amsterdam - 2014

Special Session: Flow Assurance and Multiphase Flow



Society of Petroleum Engineers

FTS Leadership - 2015

Chair: Phaneendra Kondapi, University of Houston
 First Vice-Chair: Steve Cochran, Chevron ETC
 Second Vice-Chair: Hassan Karimi, Schlumberger
 Secretary: Carolyn Koh, Colorado School of Mines
 Treasurer: John Nighswander, Schlumberger
 Technical Moderator: Taras Makogon, ConocoPhillips
 Past Chair: Jeff Creek, Chevron ETC
 Director Position No. 1: Cem Sarica, University of Tulsa
 Director Position No. 2: Scott Bufton, Universal Pegasus Intl
 Director Position No. 3: Trevor Hill, BP, UK



Society of Petroleum Engineers

2015 Activities - Houston

Lunch-Talk Programs

- | | |
|-----------------------------------|--------|
| 1. Probjot Singh, ConocoPhillips | 22-Jan |
| 2. Nikunj Patel, Oceaneering | 19-Feb |
| 3. Tommy Golczynski, AFC | 19-Mar |
| 4. Brian Skeels, FMC Technologies | 16-Apr |
| 5. Mack Shippen, Schlumberger | 20-May |
| 6. Michael Mai, Wood Group Kenny | 18-Jun |
| 7. Lee Norris, Schlumberger | 17-Sep |
| 8. Howard Duhon, GATE | 22-Oct |
| 9. Carlos Avila, Chevron | 19-Nov |



Society of Petroleum Engineers

2015 Activities - Global

- | | |
|---|------------|
| 1. Forum: FA Future State-of-the-Art , CA | 1-5, June |
| 2. ATCE FA Panel Session, Houston | 29-Sep |
| 3. ATCE FA Paper Session, Houston | 29-Sep |
| 4. FTS Members 1 st Annual Meeting | 29-Sep |
| 5. *FA Workshop, Edinburgh, UK | 13-14, Oct |
| 6. *FA Shale Workshop, Galveston, TX | 28-30, Oct |

* FTS Supported Events



Society of Petroleum Engineers

2015 Activities - Webinars

- | | |
|-----------------------------|--------|
| 1. Phaneendra Kondapi, KBR | 26-Mar |
| 2. Lee Norris, Schlumberger | 17-Sep |
| 3. Howard Duhon, GATE | 22-Oct |
| 4. Carlos Avila, Chevron | 19-Nov |

For more information, please visit
<http://connect.spe.org/fts/home/>



Society of Petroleum Engineers

Congratulations !
 Dr. Cem Sarica

for receiving

John Franklin Carll Award
 and
 Cedric A Ferguson Certificate
 at ATCE 2015



Society of Petroleum Engineers

Elections

First Elections (2015) – January 2015
 Second Elections (2016) – September 2015



Society of Petroleum Engineers

Officers Elected 2015

Second Vice-Chair: Hassan Karimi, Schlumberger
 Secretary: Carolyn Koh, Colorado School of Mines
 Director Position No. 3: Trevor Hill, BP



Society of Petroleum Engineers

New Officers-Elect 2016

Second Vice-Chair: Cem Sarica, University of Tulsa
 Treasurer: Taras Makogon, ConocoPhillips
 Technical Moderator: John Nighswander, Schlumberger
 Director Position No. 3: Jim Bennett, ExxonMobil



Society of Petroleum Engineers

Amendments to Constitution

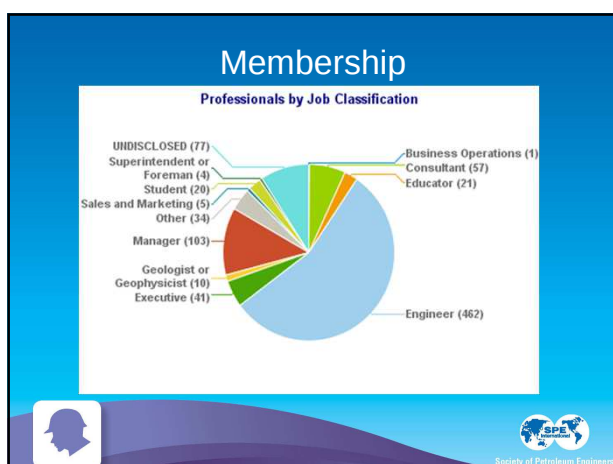
First Version – October 2013
 First Amendments – September 2015



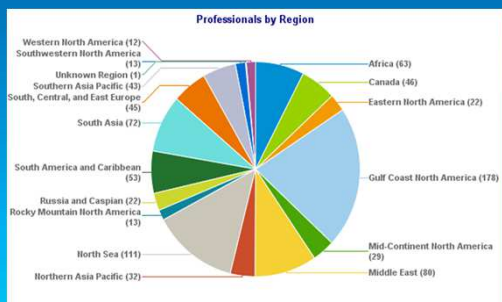
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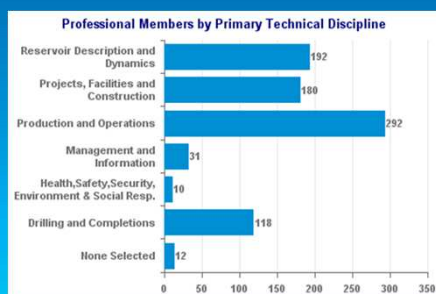


Membership



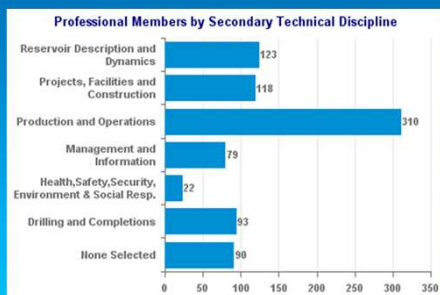
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Membership



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Membership



Society of Petroleum Engineers

Want to Get Involved With FTS?

1. Join FTS as SPE member
2. Attend Luncheon Meetings
3. Consider Sponsoring a FTS Luncheon (\$2K)
4. Attend Global Events
5. Participate in FTS Web Discussions
 - <http://connect.spe.org/fts/home/>
6. Give your ideas to a FTS leader

Not a member yet? Please click,
<https://www.spe.org/ams/Custom/OnlineCommunityPreferences.aspx>



Society of Petroleum Engineers

Thank you!

Questions?



Society of Petroleum Engineers

"A Systems Approach to Flow Assurance"



Howard Duhon

P.E.

Howard Duhon is the Systems Engineering Manager and a principal of Gibson Applied Technology and Engineering, Inc. (GATE) in Houston, TX. He has 40 years of experience in the Petrochemical and Oil and Gas industries mainly in process design and project engineering roles. For the past 15 years that work has mainly involved deepwater developments and has been focused on managing the interfaces between topsides and other disciplines. Duhon has a chemical engineering degree from the University of Louisiana at Lafayette. Throughout his career he has had a particular interest in the study of decision theory and in the application of that knowledge to improve project execution. In 2013 he was named to the SPE Board of Directors as the Projects, Facilities and Construction Technical Director.



SPE Web Events

#SPEWEBEVENTS



System Approach to Flow Assurance

What a Flow Assurance Engineer needs to know (so far)

Howard Duhon, P.E.



hduhon@gateinc.com

  #SPEWEBEVENTS

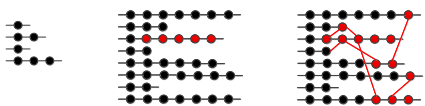


WHY SYSTEMS ENGINEERING IS IMPORTANT

Our projects are getting more complex.

Linear/predictable → Non-linear/unpredictable

Simple Complicated Complex Chaotic



  #SPEWEBEVENTS



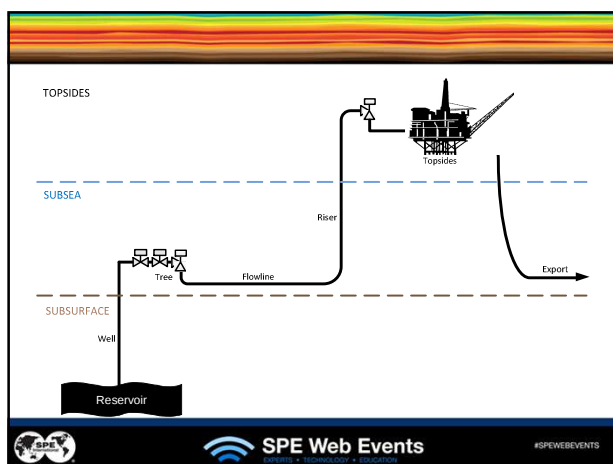
WHAT IS SYSTEMS ENGINEERING?

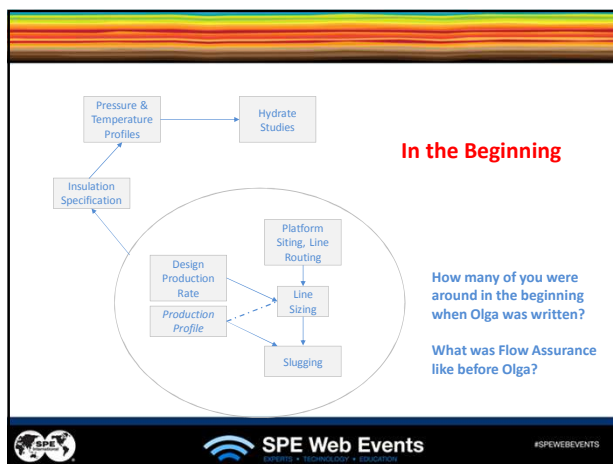
Linear/predictable → Non-linear/unpredictable

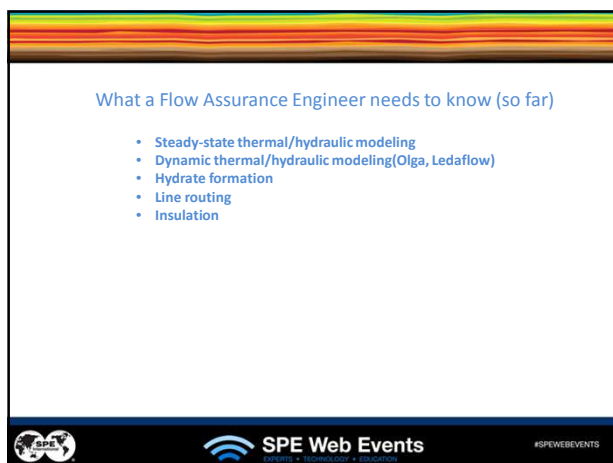
Simple Complicated Complex Chaotic

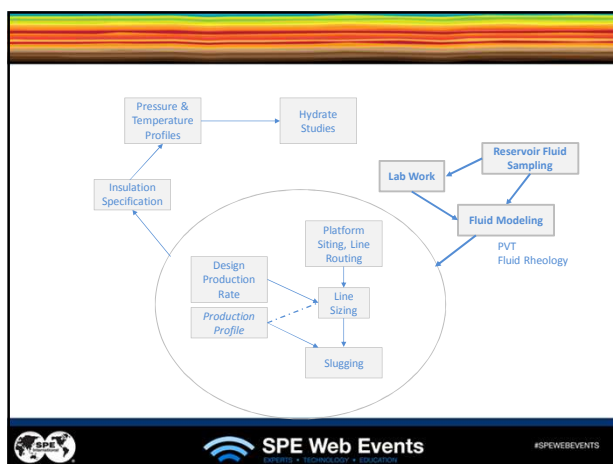
Projects are harder because they are more complex.
This complexity is caused by increased connectivity.
Systems Engineering is our answer to this complexity.
The Systems Engineer looks at the big picture and
attempts to coordinate the activities of various specialist
functions.

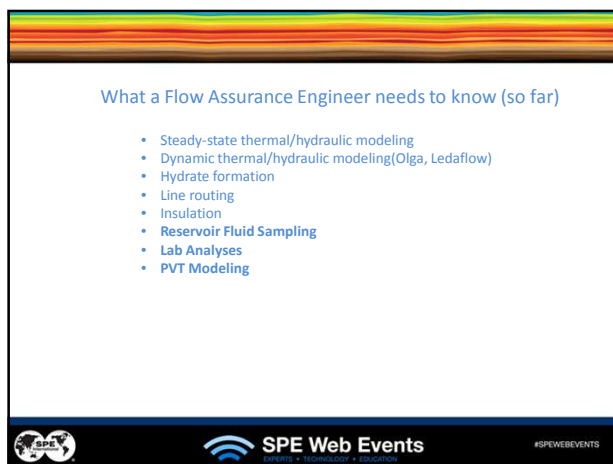
  #SPEWEBEVENTS

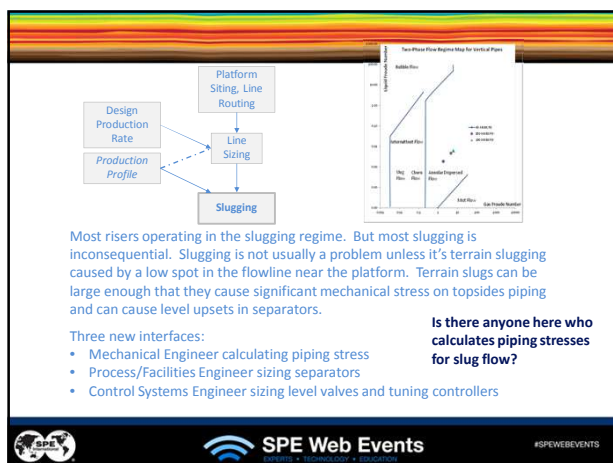


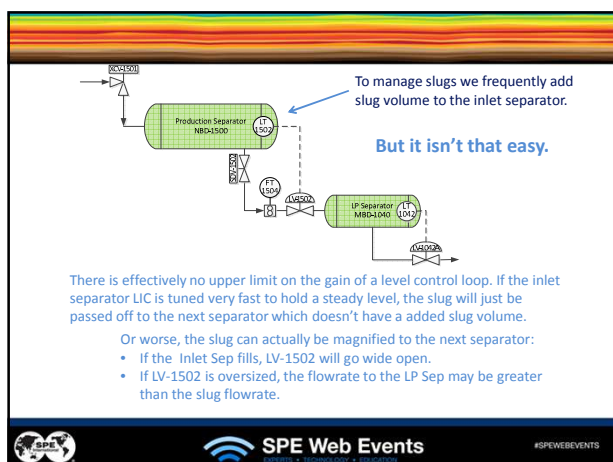


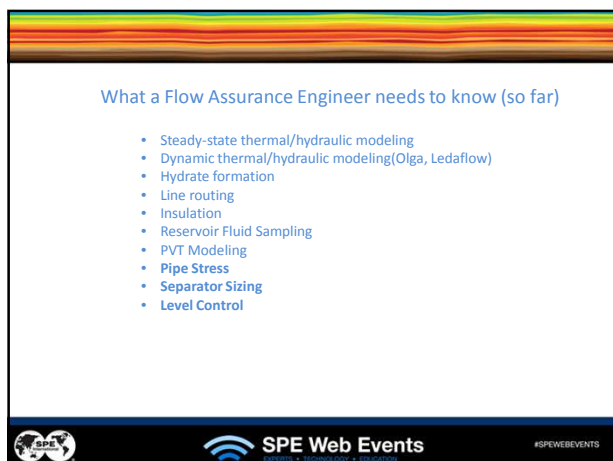


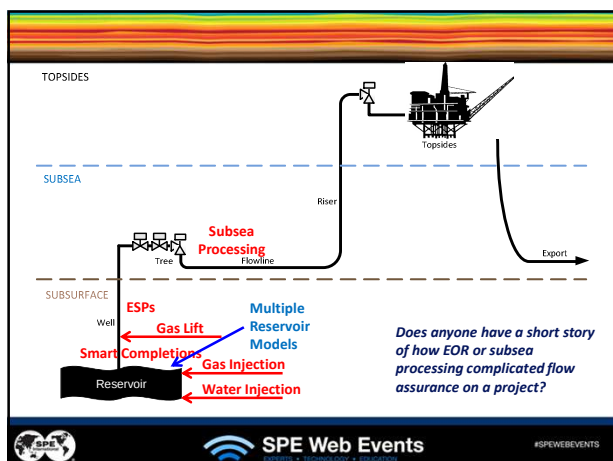


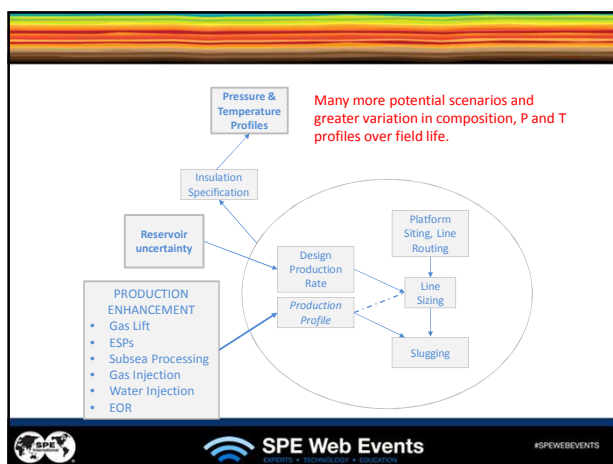


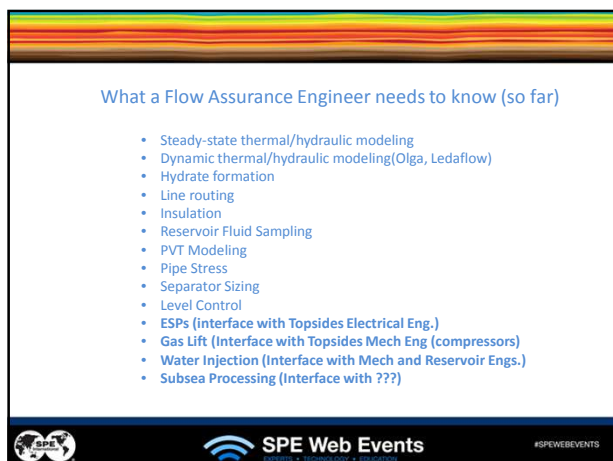


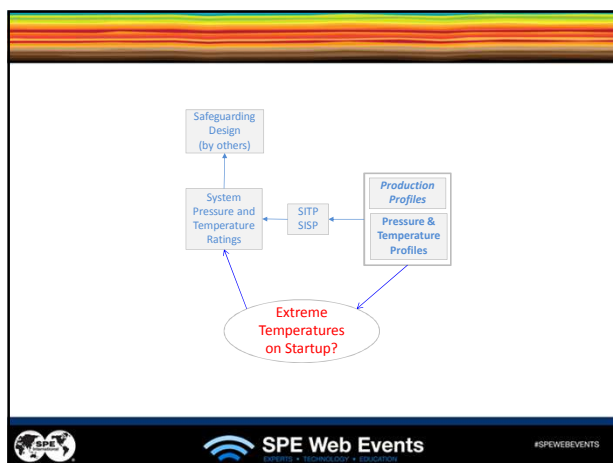


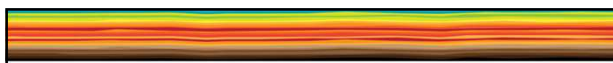










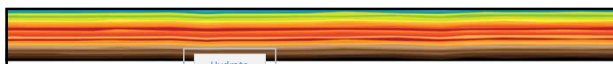


What a Flow Assurance Engineer needs to know (so far)

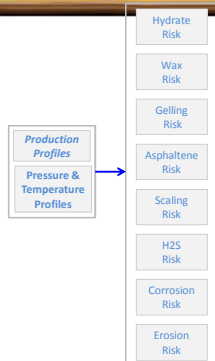
- Steady-state thermal/hydraulic modeling
- Dynamic thermal/hydraulic modeling (Olga, Ledaflow)
- Hydrate formation
- Line routing
- Insulation
- Reservoir Fluid Sampling
- PVT Modeling
- Pipe Stress
- Separator Sizing
- Level Control
- ESPs (Interface with Topsides Electrical Eng.)
- Gas Lift (Interface with Topsides Mech Eng (compressors))
- Water Injection (Interface with Mech and Reservoir Eng.)
- Subsea Processing (Interface with ???)
- Safeguarding




#SPEWEBEVENTS

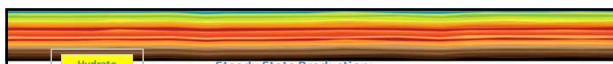


A few other considerations!





#SPEWEBEVENTS



Hydrate Risk

Wax Risk

Gelling Risk

Asphaltene Risk

Scaling Risk

H₂S Risk

Corrosion Risk

Erosion Risk

Steady State Production:

- Heat conservation
- Chemicals
 - Methanol/MEG
 - LDHI

Shutdown:

- Heat conservation (no-touch, light-touch, etc.)
- Chemicals (planned shutdown)
 - Methanol/MEG
 - LDHI
- Displacement
- Decrease pressure (flowline blowdown)

Startup:

- Heating
 - Hot oil circulation
 - Start strong, low water-cut wells first
- Chemicals
 - Methanol/MEG
 - LDHI
- Start fast – outrun hydrates




#SPEWEBEVENTS



SPE Web Events
Learning • Networking • Innovation
#SPEWEBEVENTS

Hydrate Risk

Wax Risk

Gelling Risk

Asphaltene Risk

Scaling Risk

H2S Risk

Corrosion Risk

Erosion Risk

Impacts and Interfaces

Methanol contaminates crude oil resulting in sales price penalties and potentially inability to export contaminated crude

Methanol and LDHIs impact water treating systems – may be unable to meet Oil in Grease limits for discharge.

Methanol is lighter than water, hence decreases the density of the aqueous phase. In a heavy oil system the oil phase may become the heavy phase.

Methanol dissolved in oil will change the equilibrium distribution of some water soluble hydrocarbons increasing WSO concentrations.

MEG comes with a whole host of issues when it is recovered and reused in gas production systems.



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#SPEWEBEVENTS

What a Flow Assurance Engineer needs to know (so far)

- Steady-state thermal/hydraulic modeling
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- Gas Lift (Interface with Topsides Mech Eng (compressors))
- Water Injection (Interface with Mech and Reservoir Engs.)
- Subsea Processing (Interface with ???)
- Safeguarding
- Standard ways of avoiding hydrate formation
- Export of methanol-contaminated crude
- Impact of chemicals on water treating



SPE Web Events
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#SPEWEBEVENTS

Hydrate Risk

Wax Risk

Gelling Risk

Asphaltene Risk

Scaling Risk

H2S Risk

Corrosion Risk

Erosion Risk

Impacts and Interfaces

There are multiple ways of estimating the temperature at which wax will deposit and the deposition rate as a function of temperature.

Flow assurance engineer must be able to predict wax buildup rates.

Flow assurance engineer must understand methods of avoiding wax deposition:

- Heat conservation
- Chemicals
- Dilution?

and methods of removing deposited wax:

- Heating (hot oil circulation)
- Pigging (mechanical removal)



What a Flow Assurance Engineer needs to know (so far)

- Steady-state and dynamic thermal/hydraulic modeling
- Hydrate formation
- Line routing
- Insulation
- Reservoir Fluid Sampling
- PVT Modeling
- Pipe Stress
- Separator Sizing, Level Control
- ESPs (Interface with Topsides EE)
- Gas Lift (Interface with Topsides ME)
- Water Injection (Interface with Mech and Reservoir Eng.)
- Subsea Processing
- Safeguarding
- Standard ways of avoiding hydrates
- Export of MeOH-contaminated crude
- Impact on water treating
- Wax Deposition modeling
- Wax prevention methods
- Pigging, Heating for Wax Removal

Anyone have a horror story about pigging for wax removal?




#SPEWEBEVENTS



- Hydrate Risk
- Wax Risk
- Gelling Risk
- Asphaltene Risk
- Scaling Risk
- H2S Risk
- Corrosion Risk
- Erosion Risk

Impacts and Interfaces

Gelling can be a serious flow assurance risk that is not particularly well handled by the usual flow assurance modeling tools.

Flow assurance engineer must understand methods of avoiding gelling:

- Heat conservation
- Chemicals
- Dilution?

and provide a means of clearing a gelled flowline:

- Pressure
- ??

Is a gel a Bingham plastic or not?




#SPEWEBEVENTS



- Hydrate Risk
- Wax Risk
- Gelling Risk
- Asphaltene Risk
- Scaling Risk
- H2S Risk
- Corrosion Risk
- Erosion Risk

Does temperature affect asphaltene onset pressure?

Can we predict whether asphaltenes will stick or not?

Does SARA analysis work?

Pressure maintenance. Chemical injection.

Chemical injection.

Materials of construction. Biocides. H2S Scavenging.

Materials of construction. Biocides. Chemicals.

Materials of construction. Velocity control. Piping geometry




#SPEWEBEVENTS

What a Flow Assurance Engineer needs to know (so far)

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- Wax Deposition modeling
- Wax prevention
- Pigging, Heating for wax removal
- Chemical Injection Systems**
- Materials of Construction**
- Sand Control**

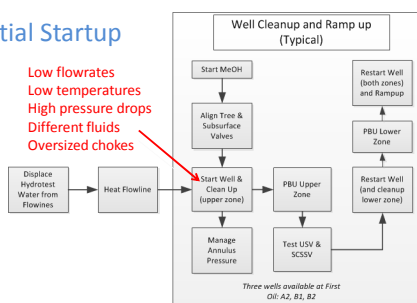


SPE Web Events

#SPEWEBEVENTS

Initial Startup

Low flowrates
Low temperatures
High pressure drops
Different fluids
Oversized chokes



SPE Web Events

#SPEWEBEVENTS

Flow Assurance in Operations

Flow Assurance Engineers have historically been used early in projects and less so in detailed design and beyond.

We now see increasing use of Flow Assurance Engineering in operations.

How many of you are involved mainly or largely doing flow assurance work to support operating assets?



SPE Web Events

#SPEWEBEVENTS

Flow Assurance in Remediating Blockages

There are a surprising number of hydrate blockages every year in deepwater.

About how many hydrate blockages occur per year in deepwater?



SPE Web Events

#SPEWEBEVENTS

What a Flow Assurance Engineer needs to know (so far)

- Steady-state and dynamic thermal/hydraulic modeling
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- Pigging, Heating for wax removal
- Chemical Injection Systems
- Materials of Construction
- Sand Control
- **Initial Startup**
- **Operations**
- **Remediating Blockages**



SPE Web Events

#SPEWEBEVENTS

John Stuart Mill died in 1873 (less than 150 years ago)

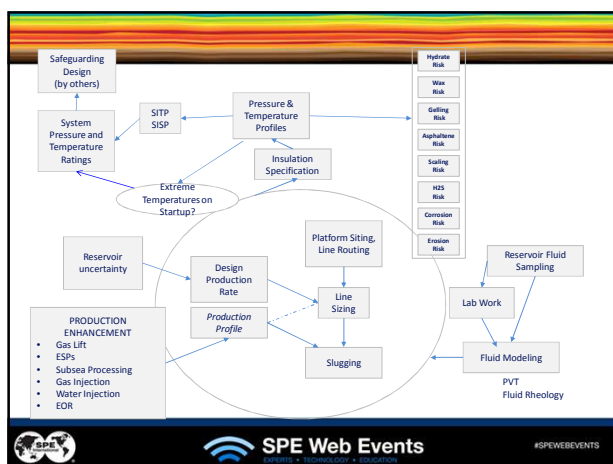
He was reputed to be the **last person who knew everything**.

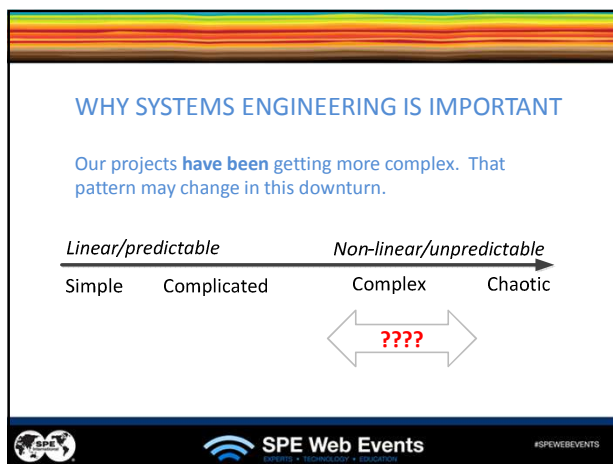
It is, of course, no longer possible to know everything. Indeed, it is impossible to know everything there is to know about even conceptually simple things; no single person could know everything there is to know today about two phase separation, for instance

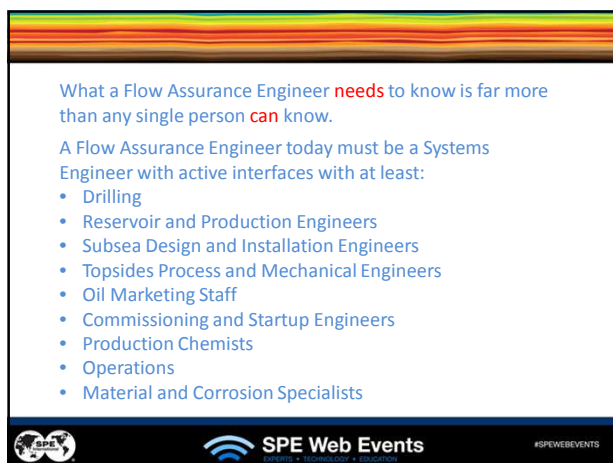


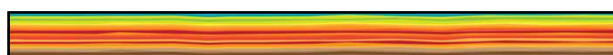
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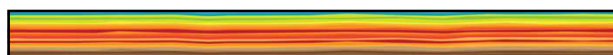
Irony !

Flow assurance is viewed as one of the most highly specialized fields in the oil patch.

Yet, to be successful, the Flow Assurance Engineer needs to be the ultimate generalist.



#SPEWEBEVENTS



Thank You

Howard Duhon, P.E.



hduhon@gateinc.com



#SPEWEBEVENTS
