

UC1999 Monterey CA video trailer

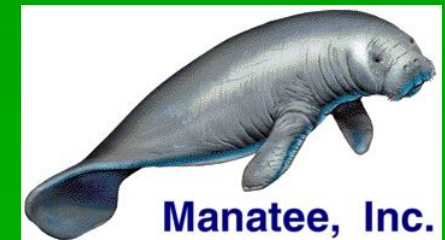




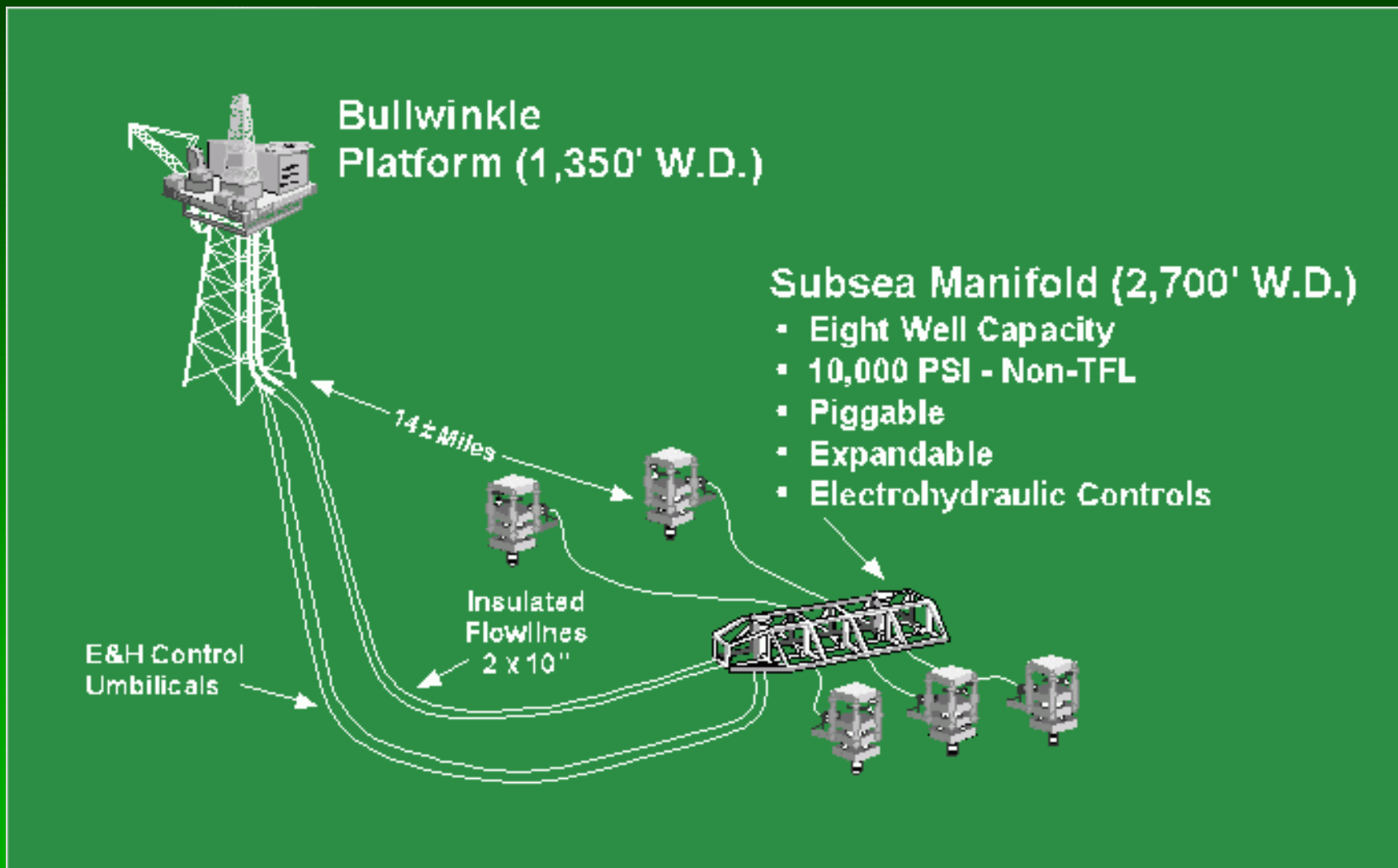
PI for Decision Support in Offshore Production Environments

A Review of BP's Troika Field

Rex L. Spahn
Manatee, Inc.



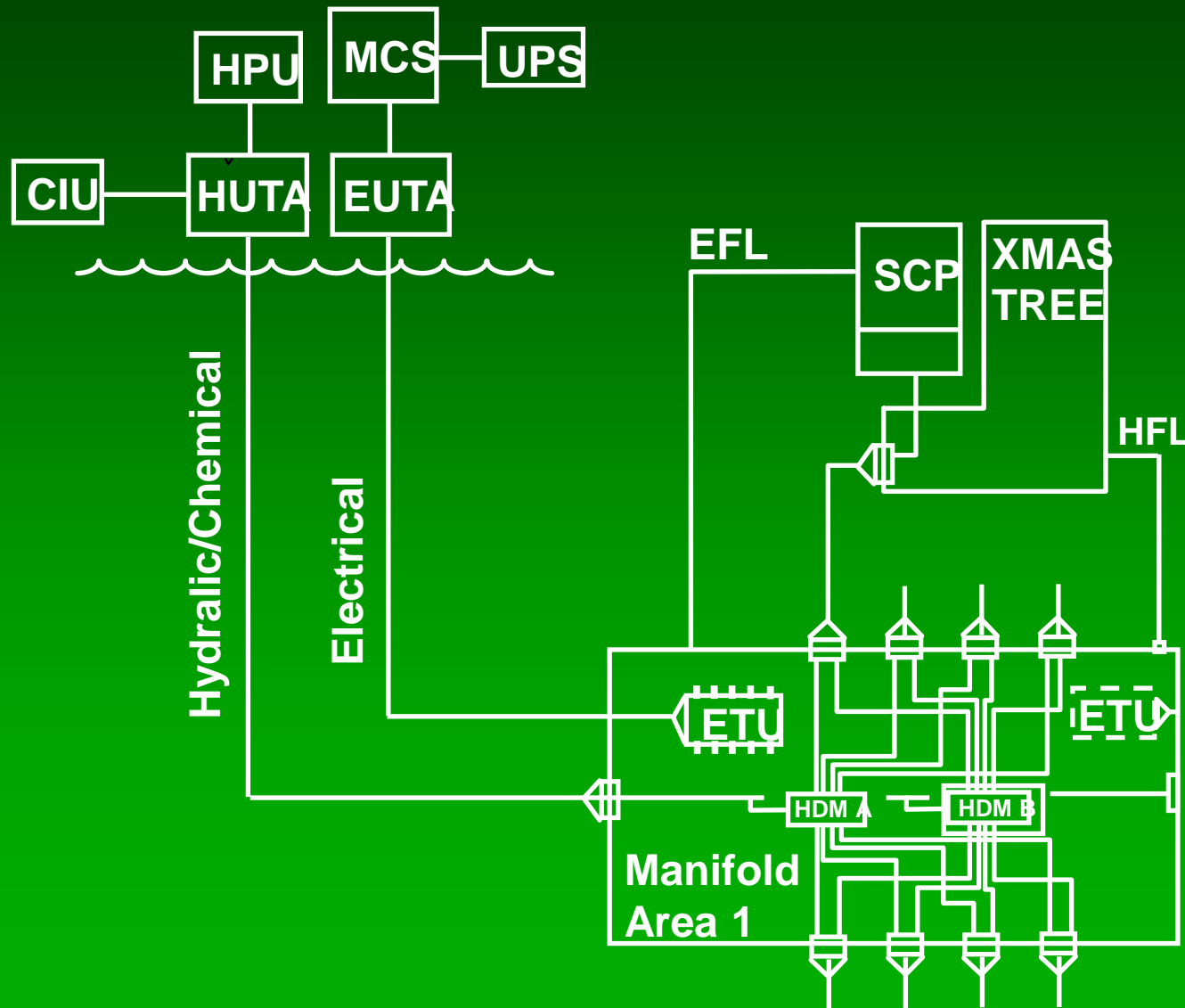
Troika Production System



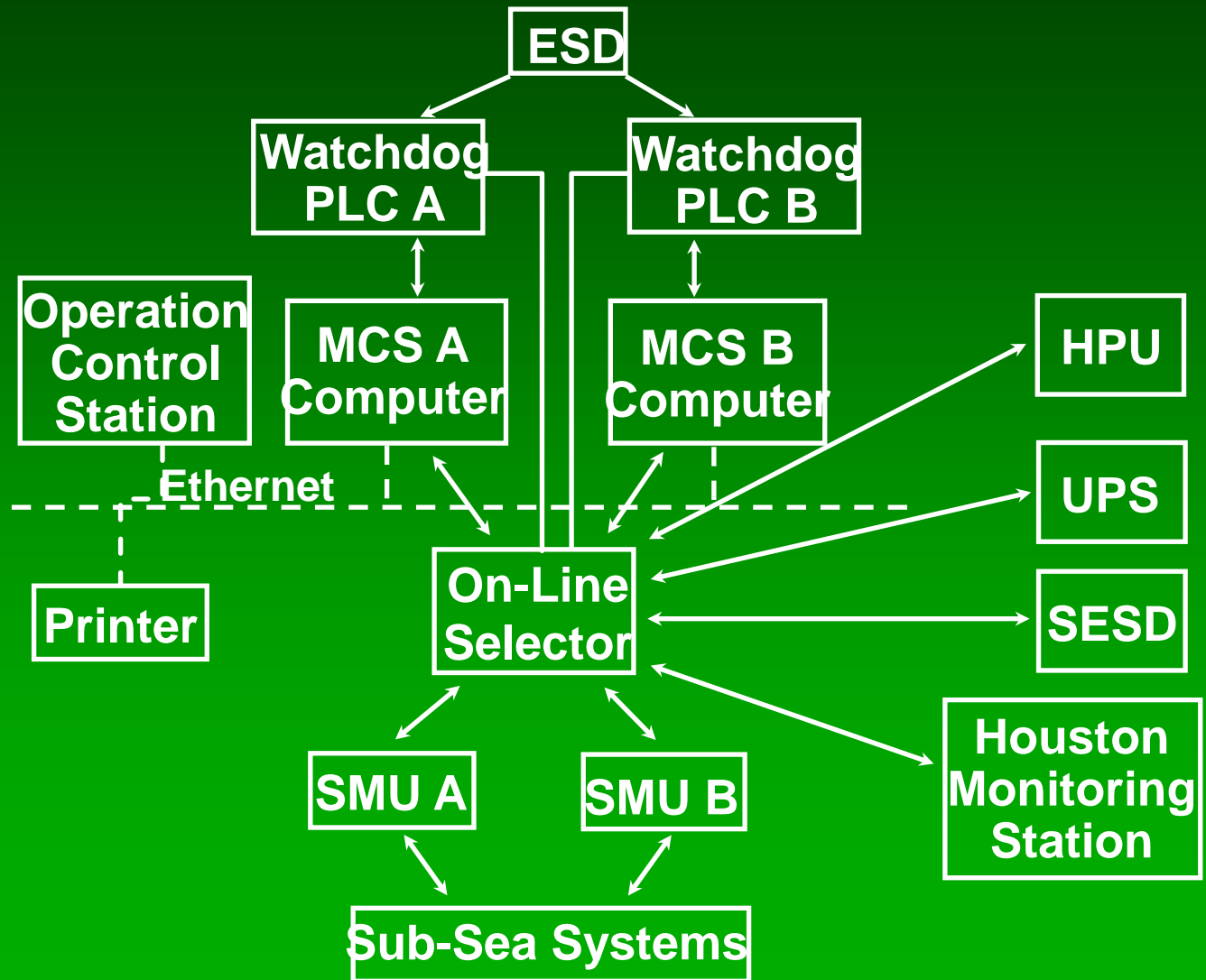
Control System Primary Functions

- **Operate hydraulically-actuated valves**
- **Take corrective actions during shut-ins caused by abnormal conditions**
- **Provide chemical injection**
- **Provide data from downhole and tree instrumentation**

Control System Layout



Control System Architecture



Troika Data Acquisition System

What is it?

- Primarily an Operational and Surveillance Database
- Production optimization (drawdown)
- History of operations
- Graphical and numerical record of data

Troika Data Acquisition System

What is being monitored?

- **Wells**

- Downhole pressure / temperature (3)
- Wellhead pressure / temperature (2)
- Flow rates calculated from downhole pressure/temperature (oil, gas, water)
- Casing pressure (1)
- Choke position (1)

- **Bullwinkle Production Platform**

- Separator pressures / temperatures (5)
- Separator rates (oil, gas, water) (7)

PI Implementation

- **Installed in fall of 1997**
 - PI server located in BP's offices
- **Batch process initially**
 - data files created daily by MCS and weekly by Bullwinkle personnel
 - data files converted and processed by PI batch file processor
- **Real-time system since mid-1998**
 - upgraded communication link
 - daily files still created for backup
 - Bullwinkle data still batch process

PI-ProcessBook for Troika

PI-ProcessBook - [Troika Process Book.piw]

File Edit View Draw Arrange Tools Window Help

Troika Wells

- Overview
 - Choke Settings
 - Bottom Hole Pressures
 - Oil Production
 - Casing Pressure
- TA-1
- TA-2
- TA-3
- TA-4
- TA-5
- TA-6
- Daily Oil Production by Well
- Daily Gas Production by Well
- Choke Positions
- Well Performance
- Production Report (PI DHF)

New Open

Office

Troika Wells

a Reports

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Microsoft

NUM

Start

Inbox - Microsoft Exchange

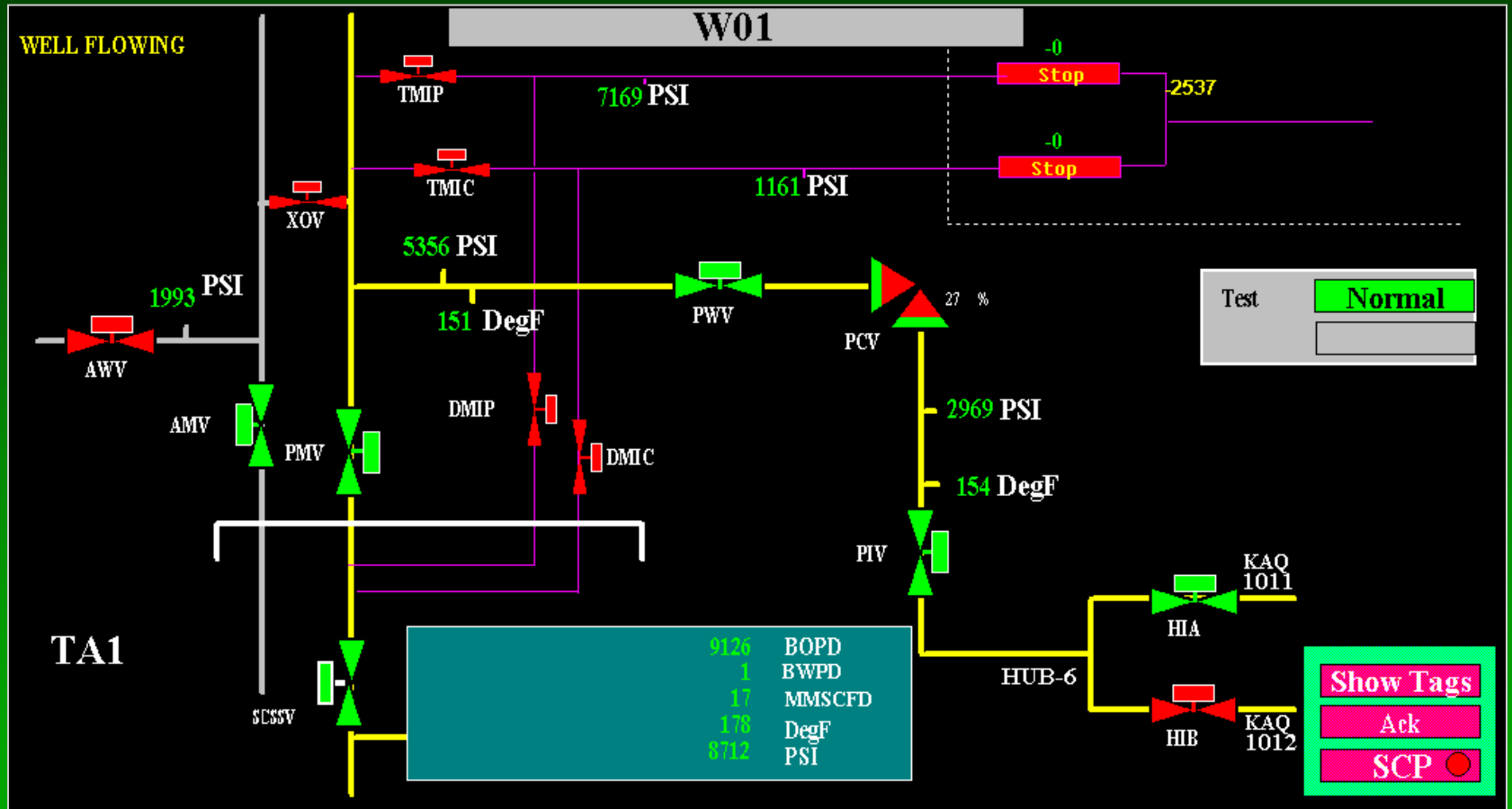
Microsoft PowerPoint - [Ga...

Microsoft Access

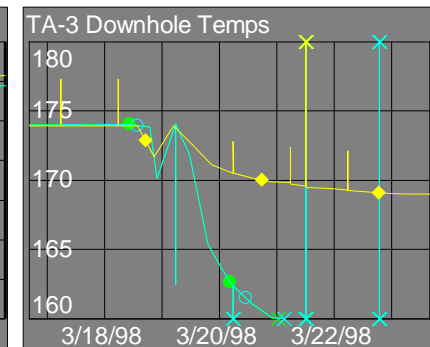
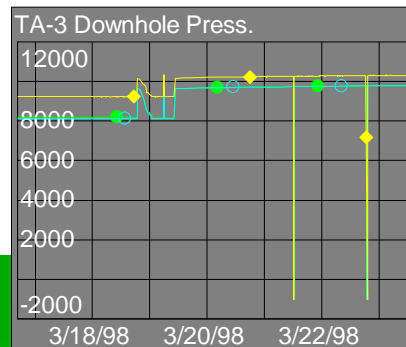
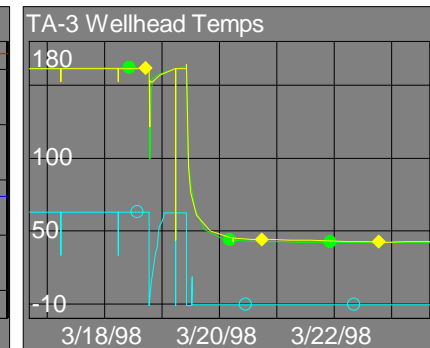
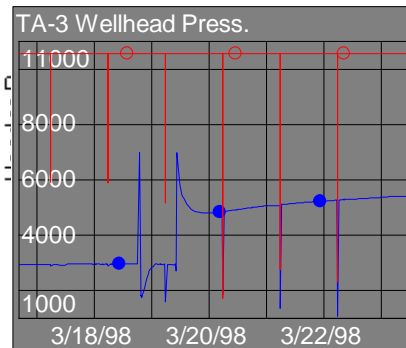
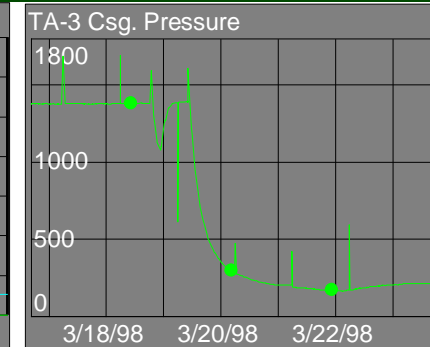
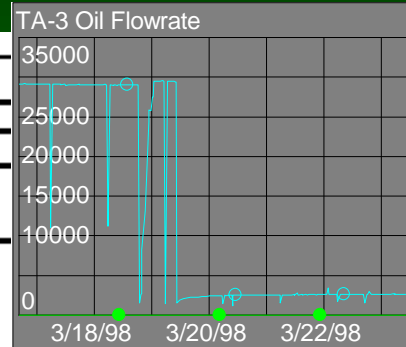
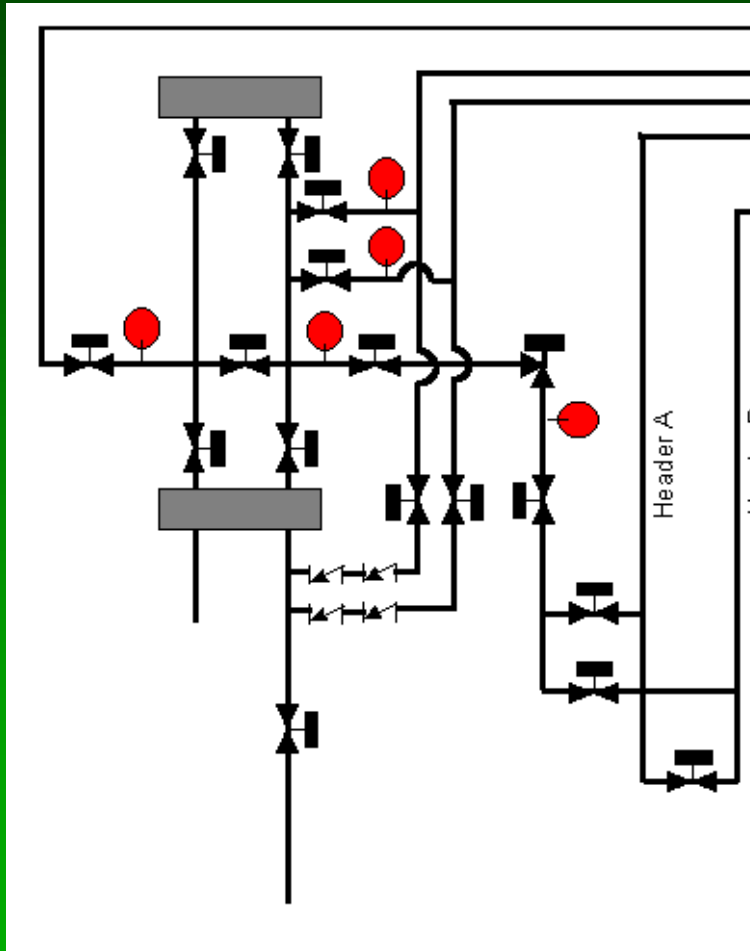
PI-ProcessBook - [Tr...

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MCS Well Mimic



PI-ProcessBook Well Mimic



MCS Summary Screen

Troika Well Production Summary

	DHP PSIA	UPT PSIA	DPT PSIA	PCV %	DHF BOPD	DHF BWPD	HDR	AP PSIA	DHF DegF	UPT DegF	DPT DegF	
1	9611	6438	2247	16	1076	-1	KAQ-1011	2044	177.8	144.7	147.3	ACK
2	9472	6439	2335	19	0	-1	KAQ-1012	1739	174.5	154.9	155.5	ACK
3	9243		2307	25	10524	-1	KAQ-1012	2016	174.2	156.6	157.4	ACK
4	0	0	0	0	1	0		0	32.0	0.0	0.0	ACK
5	10532	6279	1962	18	8490	348	KAQ-1011	1449	182.4	167.6	171.6	ACK
6	0	0	0	0	1	0		0	32.0	0.0	0.0	ACK
7	0	0	0	0	0	0		0	32.0	0.0	0.0	ACK
8	8566	0	0	0	0	0		0	131.7	0.0	0.0	ACK

Electrical

Hydraulic

Valves

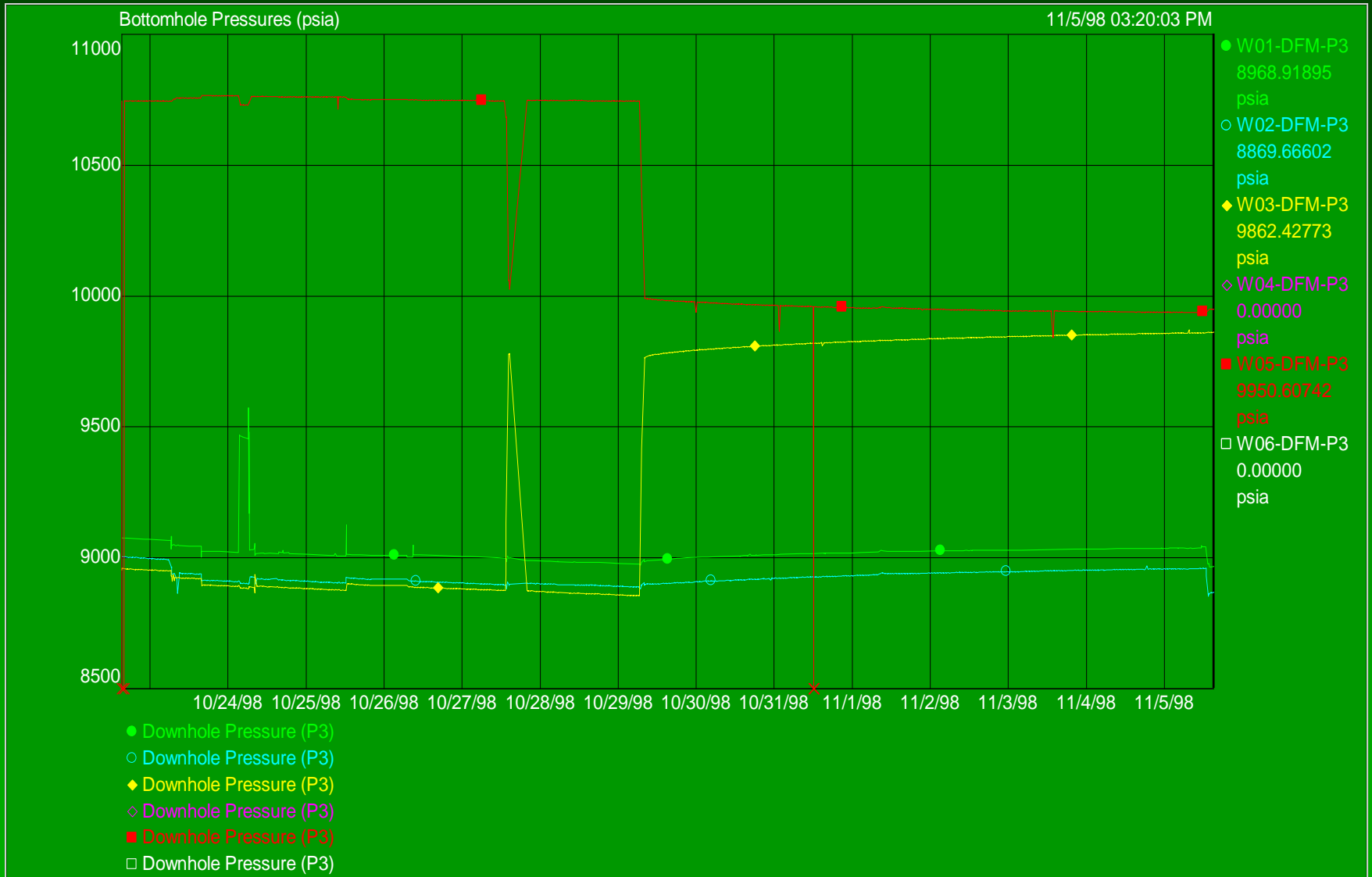
PI-ProcessBook Summary Screen

	BOPD	BWPD	MMSCFD	Production vs. Test	Choke	BHP	UP	DP	Casing Pressure	BHT	UT	DT
TA-1	3,598	-1	6.9		18.1	9,902	6,606	2,778	1,036	174	136	144
TA-2	0	-1	0.0		-0.7	10,064	6,770	2,606	380	170	43	43
TA-3	519	-1	1.1		-1.2	10,049		1,552	27	170	44	43
TA-4	1	0	0.0		0.0	0	0	0	0	32	0	0
TA-5	30,054	-763	58.9		-4.4	9,984	4,144	2,614	1,220	184	168	168
TA-6	1	0	0.0		0.0	0	0	0	0	32	0	0

Uses of Downhole Pressure Gauges

- Well management (maintain desired drawdown)
- Reservoir characterization (static and dynamic)
 - Rate & pressure simulation history match
 - Frequent PBUs without loss of production
 - Multi-rate analysis during well start-ups
- Redundancy (via nodal analysis)
- Well ramp-up and downtime history

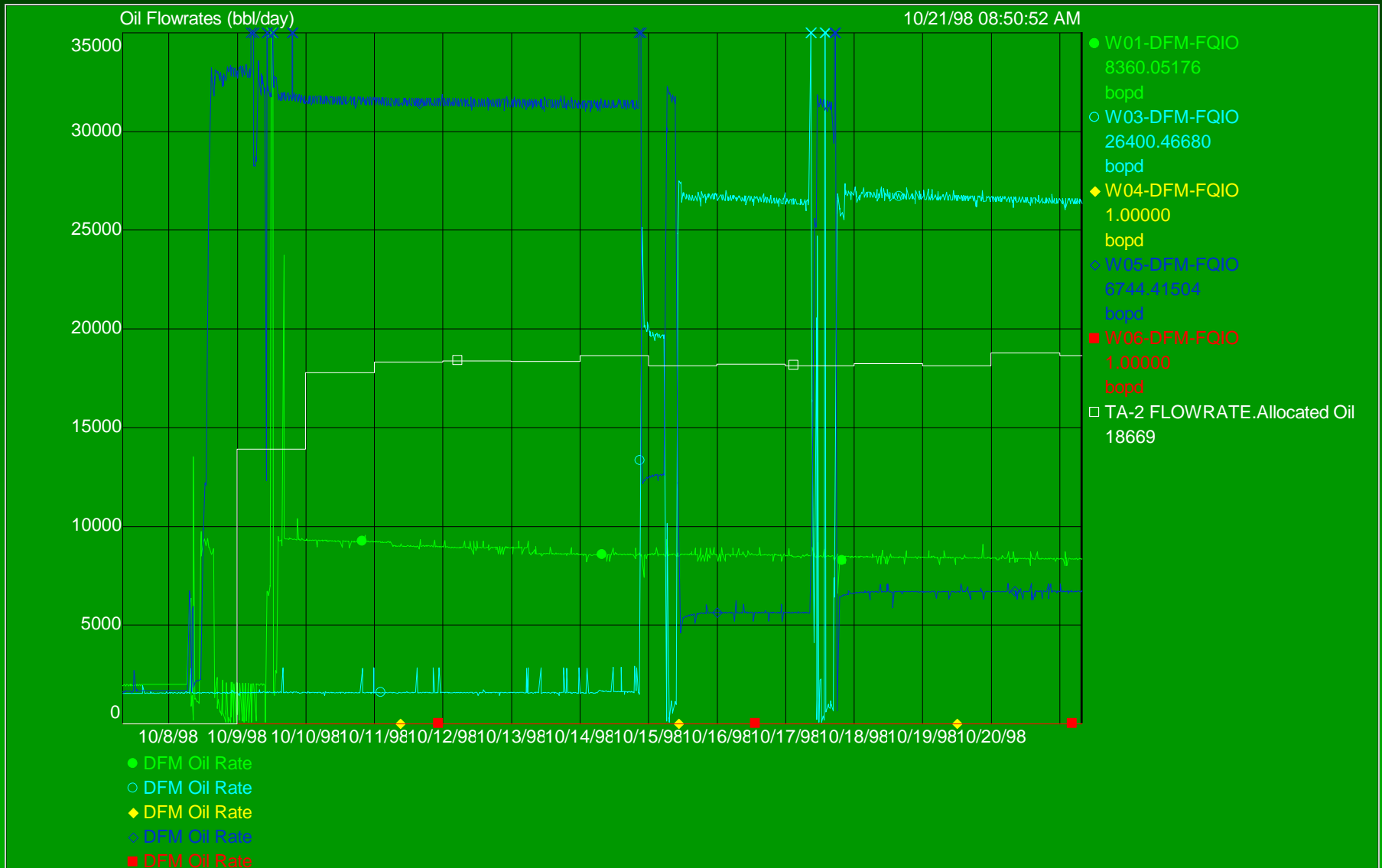
Downhole Pressure Gauge Trends



Uses of Downhole Flowmeters

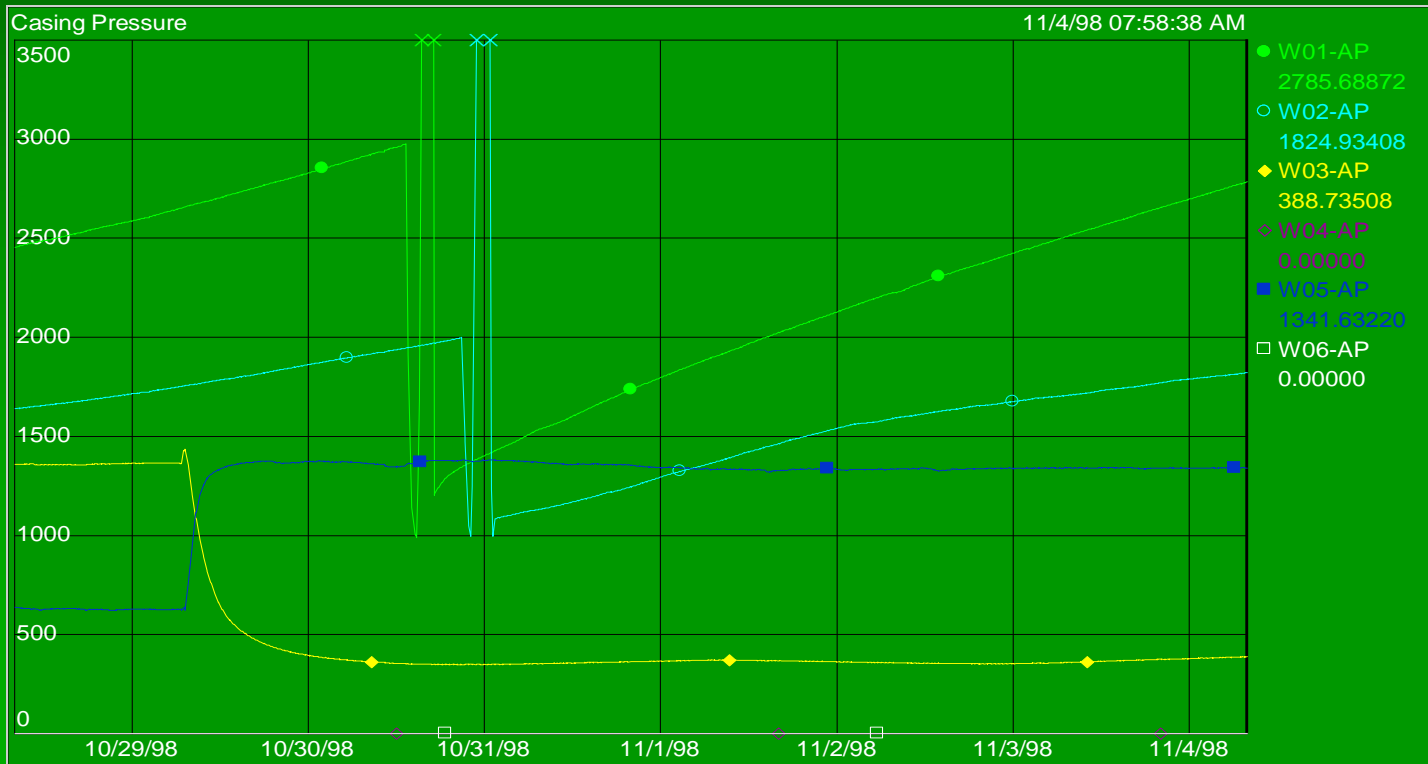
- Oil, gas and water rates calculated
- Accuracy - typically +/- 5% compared to Bullwinkle metered volumes
- Production rates used for daily production allocation to wells
- Primary well test method
- Redundancy (via nodal analysis)
- Downtime

Downhole Flowmeters



Annulus Pressure Monitoring

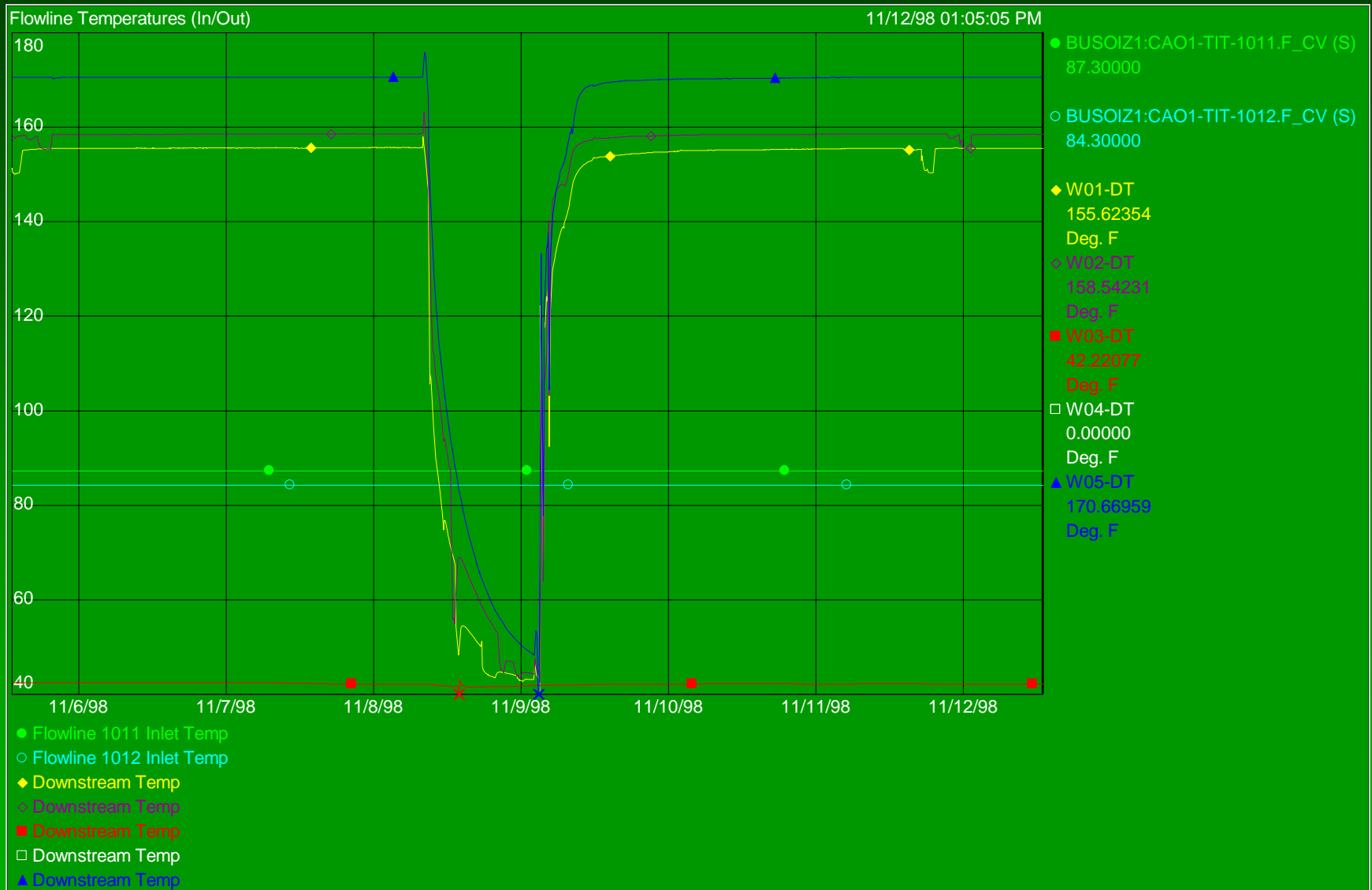
- As production begins, annulus heats up and fluids expand
- Pressure in annulus continuously monitored and bled off at 3000 psia



Flowline Monitoring

- **Easy access to historical data**
- **Flowline thermal data**
 - wellhead temperatures (inlet)
 - fluid temperatures at Bullwinkle (outlet)
 - production rates
- **Flowline model used to:**
 - monitor flowline performance
 - predict performance at other rates
 - determine pigging schedule for paraffin removal

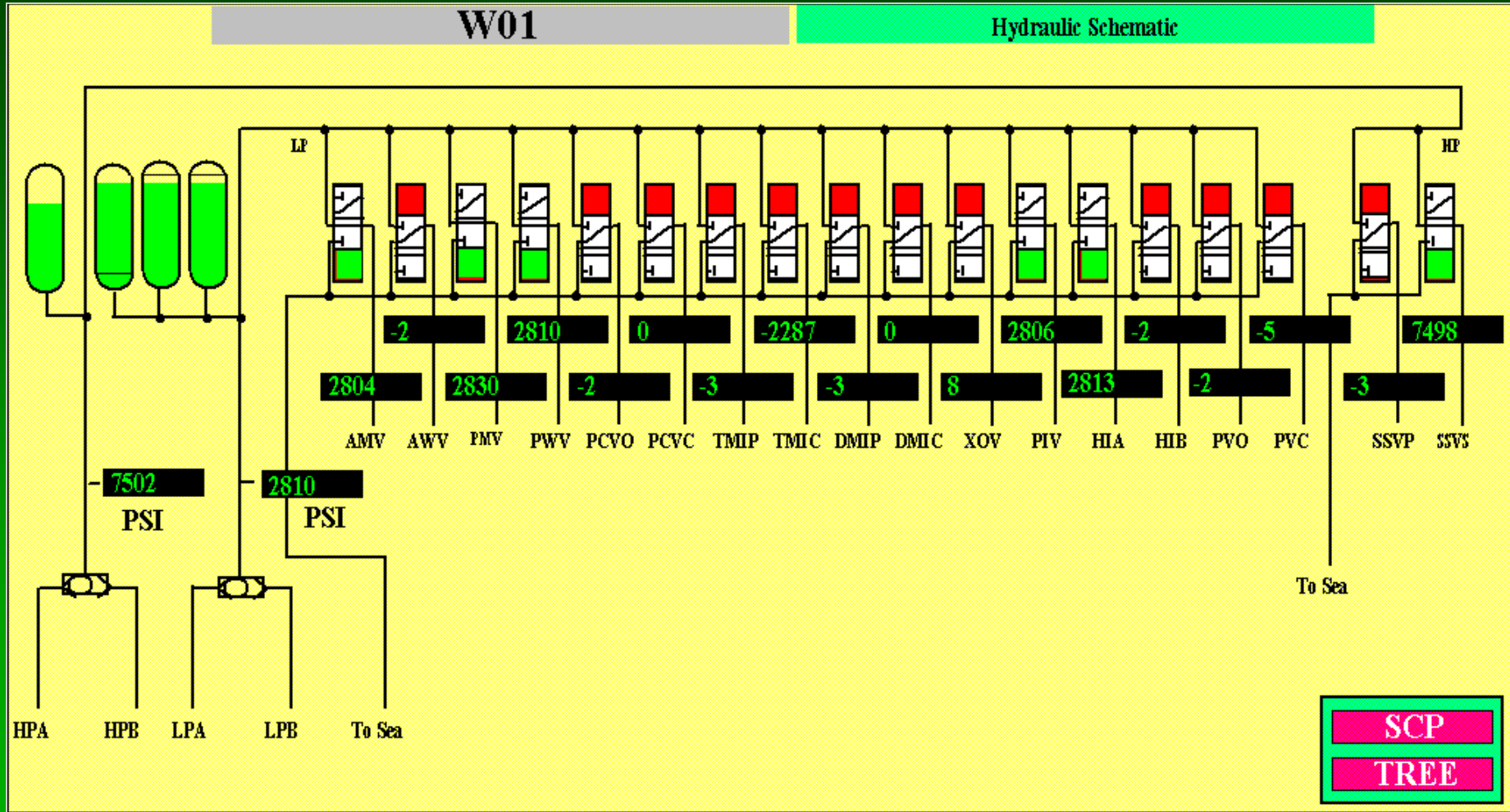
Flowline Temperature Data



Preventive Maintenance Planning

- **Maintenance critical on subsea system due to high cost of repairs**
- **Preventive Maintenance (PM) program key to achieving desired operating expenses**
- **Data important to PM program:**
 - valve operating cycles
 - hydraulic pressures
 - valve positions

Preventive Maintenance Data



Key Benefits of PI

- **Ability to place key information on right person's desk**
 - lower cost per desktop than control system
- **Critical data stored within PI**
- **With RAS connection, real-time and historical data can be accessed from most anywhere**

Other Benefits

- **Historical data easy to access and trend**
- **Real-time and historical analysis of data performed using Excel™-based Datalink**
- **Well downtime calculated consistently**
- **Unusual events can be reviewed by experts to aid in diagnosis**

Future Considerations

- **Include PI in planning overall data management strategy**
- **Use PI-ProcessBook as primary data interface within control system**
 - use control system to issue commands and react to abnormal conditions
 - leave the data to PI
- **Locate PI server offshore to ensure data integrity**

Conclusions

- **Real time and historical data is valuable**
 - historical trends of reservoir characteristics
 - monitor flowline & system performance
 - diagnose problems
 - improve overall production efficiency
- **Significant production increase attributed to data monitoring system**
- **PI being implemented at other BP Amoco offshore production facilities**



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