

# Process Data for SmartPlant Instrumentation

**FLUOR**

SmartPlant ©

Implementation Team



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**FLUOR**®

# Process Department Issues



## ◆ Identifying Process Customer

- The Process Data is not a project deliverable to the Client on most projects
- The Primary Process Customer is Control Systems for the Sizing and Calibration of the Inline Instrument devices
- Mechanical and Piping also use the Process Design Conditions for equipment and line sizing and material spec

## ◆ Additional Process Hours for SPI loading

- Process develops initial Process Data on spreadsheets using the stream data and material balance
- Additional time to enter this data into SPI is not normally estimated in the Process Home Office Man Hour Estimate
- It is the responsibility of Control Systems to make the SPI data loading as efficient as possible for Process

# Process Department Issues



## ◆ Change Control in SmartPlant Instrumentation

- Because of the Critical and Dynamic nature of process data it is important that Change Management Procedures be in place on every project.
- The Process Engineer is the Owner of the Process Data in SmartPlant Instrumentation

## ◆ Process Training for SmartPlant Instrumentation

- It is the responsibility of the Control Systems SmartPlant Instrumentation administrator to Train the Process Engineers in the use of the Process Module
- Use the SPI Process Module tutorial provided by Intergraph
- Supplemental Training of Browser and Save As functions

# Current Process Data Work Practices



- ◆ **Hard copied process datasheets**
  - Process issues paper copies of Process Datasheets
  - Requires Control Systems to manually load Process data into SPI and requires some interpretation by SPI users.
- ◆ **Excel Process datasheets**
  - Process can issue Excel Spreadsheet Datasheets
  - Requires Control Systems to manually load Process data into SPI but has some Cut and Paste capability
- ◆ **Process Loads Process data into another tool for import into SPI**
  - Complex method that brakes chain of data ownership
- ◆ **Process Loads Process data directly into SPI**
  - Preferred method but requires SPI trained Process users

# SPI Process Data Module

- ◆ Tag data is the primary process loading method.
  - General Instrument area
  - Process Properties area
  - Additional Properties
  - Base conditions area
  - Alarm conditions area
  - API 2540 Standards
  - User Defined Fields
  - Process Notes Area

- ◆ Different Process Functions Require Different Process Data

GENERAL

Case: CASE 1

Service: Feed from V-8      Location: Line

Fluid state: Liquid      Line number: 4" P:1501-11H

Fluid phase: Single phase      Line size: 4 in

Fluid name source: User-defined      Line schedule: 80

Fluid name: Lean Feed

PROPERTIES

Report flags: Specific Gravity    Density    Molecular Mass

	@Minimum	@Normal	@Maximum	Units	
Volumetric flow:	25	30	32	m <sup>3</sup> /h	@flow
Upstream pressure:	12	13	14	bar	gage
Temperature:	150	150	150	°C	
Viscosity:	0.1	0.1	0.1	cP	
Velocity:	0.936	1.12	1.2	m/s	
Density:	890	890	890	kg/m <sup>3</sup>	
Specific gravity:	0.891	0.891	0.891		
Compressibility:					
Specific heats ratio:					
Vapour pressure:	0.9	0.9	0.9	bar	gage
Critical pressure:	1200			bar	gage
Molecular mass:					

ADDITIONAL PROPERTIES

Design pressure minimum:		bar	gage	Corrosive:	No
Design pressure maximum:	50	bar	gage	Erosive:	No
Design temperature minimum:		°C		Toxic:	No
Design temperature maximum:	250			Colored:	
Entrained gas:		%		Transparent:	
Angle of repose:		°		Build-up tendency:	
Required range:	From: 0	To: 36	m <sup>3</sup> /h	@flow	
Limits on press.drop across flowmeter:			mmH <sub>2</sub> O	4°	

BASE CONDITIONS

Pressure:	1	bar	absolute	Density:		kg/m <sup>3</sup>
Temperature:	15.5	°C		Specific gravity:		
				Compressibility:		

ALARM

	Alarm	Trip	Engineering units:	
Low-Low-Low:			m <sup>3</sup> /h	@flow
Low-Low:				
Low:				
High:				
High-High:				
High-High-High:				

API 2540 STANDARD

Density at reference temperature:      kg/m<sup>3</sup>

Specific gravity at reference temperature:

\*API settings for: minimum/normal/maximum:

Reference temperature:      °C

USER DEFINED FIELD

NOTE



# Instrument Process Data Module

- ◆ Handles multiple Cases
- ◆ Fluid properties lookups
- ◆ Data entered by Tag or Line
- ◆ Unit of Measure conversion
- ◆ Copy data from other Tags
- ◆ Additional Properties
- ◆ Base Conditions
- ◆ Alarm / Trip Settings
- ◆ User Defined Fields
- ◆ Workflow control
- ◆ Process datasheets with Revisions

GENERAL					
Case name:	Case 1				
Tag number:	101-FE -100				
Service:	Feed from V-5	Location:	Line		
Fluid state:	Liquo	Line number:	4--P-1501-11H		
Fluid phase:	Single phase	Line size:	4 in		
Fluid name:	Lean Feed	Line schedule:	50		
PROPERTIES					
	@Minimum	@Normal	@Maximum	Units	
Volumetric flow:	25	30	32	m <sup>3</sup> /h@flow	
Upstream pressure:	12	13	14	bar-q	
Temperature:	150	150	150	°C	
Viscosity:	0.1	0.1	0.1	cP	
Velocity:	0.636	1.12	1.2	ms	
Density:	850	850	850	kg/m <sup>3</sup>	
Specific gravity:	0.891	0.891	0.891		
Compressibility:					
Vapour pressure:	0.9	0.9	0.9	bar-q	
Critical pressure:	1200			bar-q	
ADDITIONAL PROPERTIES					
Design pressure min:		bar-q		Corrosive:	No
Design pressure max:	50	bar-q		Erosive:	No
Design temperature min:		°C		Toxic:	No
Design temperature max:	250	°C		Colored:	
Entrained gas:		%		Transparent:	
Required slope:	From: 0		To: 35	m <sup>3</sup> /h@flow	Build-up tendency
Limits on press.drop across flowmeter:		mmH2O 4°C			Angle of repose: *
Check Out					
BASE CONDITIONS					
Pressure:	1	bar-a		Density:	
Temperature:	15.5	°C		Specific gravity:	
				Compressibility:	
ALARM					
Low-Low-Low:		Alarm	Trip	Engineering units:	m <sup>3</sup> /h@flow
Low-Low:					
Low:					
High:					
High-High:					
High-High-High:					
Shutdown Code:					
API 2540 STANDARD					
USER DEFINED FIELD					
NOTE					
			FLOW PROCESS DATA SHEET		<b>INTERGRAPH</b> Process • Power • Offshore
			Domain: DEMO		
0	MS	11/19/1998	For instrumentation	Date: 4/13/2004	Sheet 1 of 1
No.	By	Date	Description	Drawing number: 101-FE -100/PD	Rev: 0

# Process Data Module



## ◆ PROCESS WORK FLOW

Status	Description	Set / Changed by
Process Data not Required	Tags that do not require process data and therefore are not available to the process engineering group	Set by <b>Instrument Engineers</b> Changed by <b>Instrument Engineers</b>
Process Data Required	Tags available for process data entry by the process engineering group (in the Process Data module or Browser).	Set by <b>Instrument Engineers</b> Changed by <b>Process Engineers</b>
Lock out from Instrument	Tags marked for editing by the process engineering group and not available to the instrument group.	Set by <b>Process Engineers</b> Changed by <b>Process Engineers</b>
Release to Instrument	Tags available to the instrument engineering group following release from the process group.	Set by <b>Process Engineers</b> Changed by <b>Instrument Engineers</b>
Lock out from Process	Tags not available to the process engineering group.	Set by <b>Instrument Engineers</b> Changed by <b>Instrument Engineers</b>

# Process Data Module



## ◆ Data Required from Process Department

- **Inlines;** Process Data for inline devices (control valves and flow elements) and analyzers are furnished by Process. Depending on the project scope, Relief Valve Process Data may be required to be furnished to Control Systems by Process Engineering.

## ◆ Data NOT Required from Process Department

- **Offlines;** Data for off-line instruments (transmitters, temperature elements, pressure elements, etc.) is collected by Control Systems from the inline device data, line list, mechanical equipment data sheets and other sources. On a work share project, it may be possible to have personnel in another office, such as a GEC, enter some or all of this data. The work process for doing so will be the responsibility of Control Systems.
- **Piping Inlines;** For Thermowell velocity calculations, Control Systems will utilize the inline device data, line list and other sources for applicable installations. For those Thermowells where flow information is not available from other sources, Process will be consulted.





# SPI Line Data Table

- ◆ Line Data Table maintains the piping line data as required for material and sizing

Select Line

Line type: PROCESS  Show all line types

Find line:

Line Number	P&ID Number	Stream Name	PD Exists	Pipe Standard	Pipe Ma
1"-FL-5001-15			Yes	ANSI	304 S.S
2"-C-1003-3C			Yes	ANSI	304 S.S
3"-FD-1212-4C			Yes	ANSI	PLAIN C
3"-FD-1213-4C			Yes	ANSI	PLAIN C
4"-P-1501-11H			Yes	ANSI	PLAIN C
4"-P-1502-11H			Yes	ANSI	PLAIN C
4"-P-1503-11H			No	ANSI	PLAIN C
FD FDD			No	ANSI	PLAIN C

OK Cancel Properties New... Change Type... Help

# SPI Line Properties



- ◆ Line Properties dialog box allows the editing of line materials, Size, Schedule and dimensions

The screenshot shows a software dialog box titled "Line Properties" with a "Select Line" sidebar. The sidebar lists line types and numbers, with "1\"-FL-5001-15" selected. The main dialog box contains the following fields:

Field	Value
Line number:	1\"-FL-5001-15
Pipe standard:	ANSI
P&ID:	
Line size:	1 in
Stream name:	
Internal diameter:	0.957
Pipe material:	304 S.S.
Line schedule:	80S
Pipe spec:	
Wall thickness:	0.179

Buttons at the bottom: OK, Cancel, Pipe Data..., Help.



# SPI Pipe Data lookup Table

- ◆ The Pipe Data Lookup Table will allow selection of the proper Pipe Schedule for a given size from the line class specification report.

Nominal Size (inch)	Pipe Schedule	Internal Diameter (inch)	Wall Thickness (inch)
1	80S	0.9570	0.1790
1	40S	1.0490	0.1330
1	10S	1.0970	0.1090
1	5S	1.1850	0.0650
1 1/4	80S	1.2780	0.1910
1 1/4	40S	1.3800	0.1400
1 1/4	10S	1.4420	0.1090
1 1/4	5S	1.5300	0.0650



# SPI Process Data Module

- ◆ Line data automatically placed in Process Data Module

**GENERAL**

Case: [ ]  
Service: Feed from V-8  
Fluid state: Liquid [v]  
Fluid phase: Single phase [v]  
Fluid name source: Database [v]  
Fluid name: [ ]  
Location: Line  
Line number: 4"-P-1501-11H [v]  
Line size: 4 in  
Line schedule: 80

Stream name: [ ]  
Pipe material: 304 S.S.  
Pipe spec: [ ]

1	10S	1.0970	0.1888
1	5S	1.1850	0.0650
1 1/4	80S	1.2780	0.1910
1 1/4	40S	1.3800	0.1400
1 1/4	10S	1.4420	0.1090
1 1/4	5S	1.5300	0.0650

Find nominal size: [ ]

OK Cancel Help





# Instrument Process Data Module

- ◆ Process Engineers enter data directly into SPI for Calculations and Instrument Spec Sheets.

**INtools - DEMO**

File Modules Edit Actions Options Framework Tools Window Help

Close Export Browser Index Inst. Specs Wiring Proc. Data Calculation Loop Dwgs. DDP Help

**Flowmeter Process Data - 101-FE - 100**

**GENERAL**

Case: Case 1  
Service: Feed from V-8  
Fluid state: Liquid  
Fluid phase: Single phase  
Fluid name source: User-defined  
Fluid name: Lean Feed  
Location: Line  
Line number: 4"-P-150  
Line size: 4  
Line schedule: 80

**PROPERTIES**

Report flags: Specific Gravity Density Molecular Mass

	@Minimum	@Normal	@Maximum	Units	
Volumetric flow:	25	30	32	m <sup>3</sup> /h	@flow
Upstream pressure:	12	13	14	bar	gage

Instrument Line Save Report Highlight Add Case Delete Case

Ready Plant: New Refinerv Area: Crude Area Unit: Crude unit 1 4/13/2004 10:12



# Instrument Process Data Module

- ◆ Process Engineers may enter fluid properties manually or select from internal database.

GENERAL																		
Case:																		
Service:	Feed from V-8	Location:	Line															
Fluid state:	Liquid	Line number:	4''-P-1501-11H															
Fluid phase:	Single phase	Line size:	4 in															
Fluid name source:	Database	Line schedule:	80															
Fluid name:																		
	<table border="1"><thead><tr><th>Fluid Name</th><th>Fluid Formula</th><th>Chemical Abstracts Name</th></tr></thead><tbody><tr><td>1,2-BUTADIENE</td><td>C4H6</td><td>1,2-BUTADIENE</td></tr><tr><td>1,2-DICHLOROETHANE</td><td>C2H4CL2</td><td>ETHANE 1,2-DICHLORO-</td></tr><tr><td>1,2-DIMETHYLBENZENE</td><td>C8H10</td><td>BENZENE,1,2-DIMETHYL-</td></tr><tr><td>1,2-ETHANEDIOL</td><td>C2H6O2</td><td>1,2-ETHANEDIOL</td></tr></tbody></table>	Fluid Name	Fluid Formula	Chemical Abstracts Name	1,2-BUTADIENE	C4H6	1,2-BUTADIENE	1,2-DICHLOROETHANE	C2H4CL2	ETHANE 1,2-DICHLORO-	1,2-DIMETHYLBENZENE	C8H10	BENZENE,1,2-DIMETHYL-	1,2-ETHANEDIOL	C2H6O2	1,2-ETHANEDIOL		
Fluid Name	Fluid Formula	Chemical Abstracts Name																
1,2-BUTADIENE	C4H6	1,2-BUTADIENE																
1,2-DICHLOROETHANE	C2H4CL2	ETHANE 1,2-DICHLORO-																
1,2-DIMETHYLBENZENE	C8H10	BENZENE,1,2-DIMETHYL-																
1,2-ETHANEDIOL	C2H6O2	1,2-ETHANEDIOL																
Report flags:																		



# Instrument Process Data Module

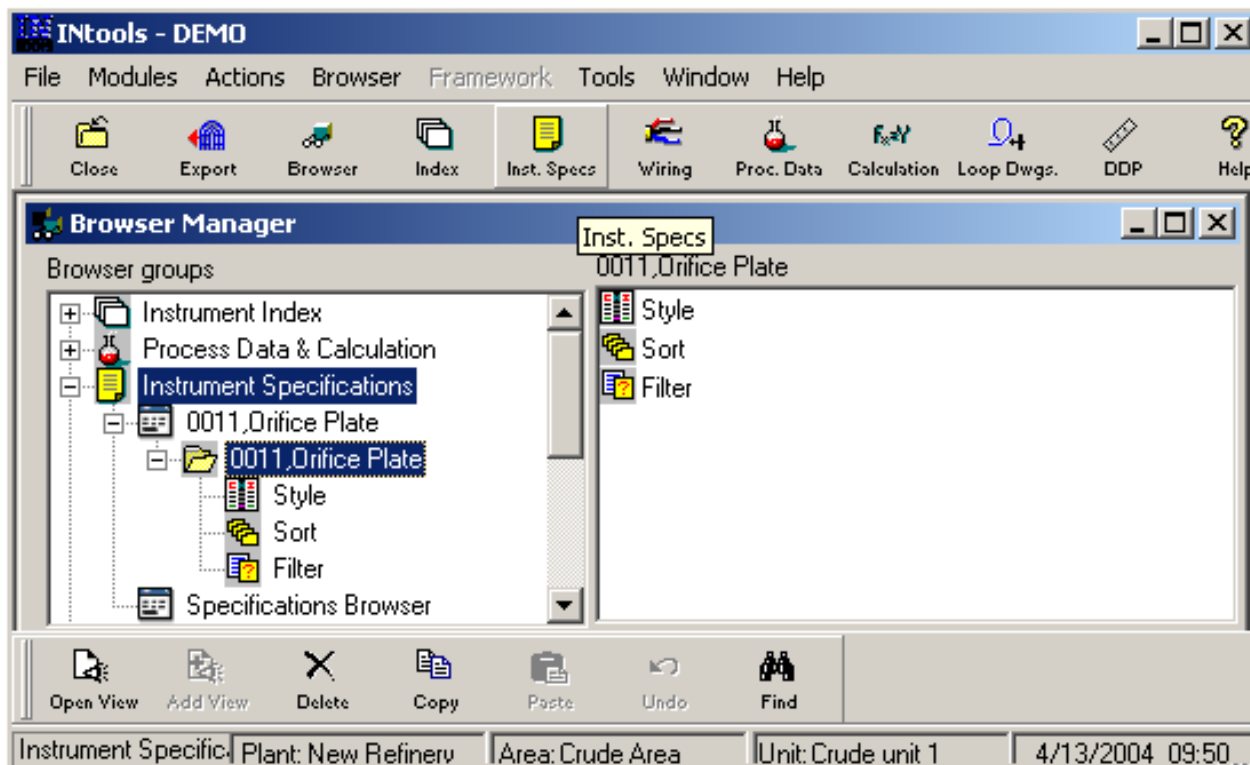
- ◆ Process Engineers may select hydrocarbon properties from the internal API 2540 table.

GENERAL			
Case:	<input type="text"/>		
Service:	<input type="text" value="Feed from V-8"/>	Location:	<input type="text" value="Line"/>
Fluid state:	<input type="text" value="Liquid"/>	Line number:	<input -p-1501-11h"="" type="text" value="4\"/>
Fluid phase:	<input type="text" value="Single phase"/>	Line size:	<input type="text" value="4"/> in
Fluid name source:	<input type="text" value="API 2540"/>	Line schedule:	<input type="text" value="80"/>
Fluid name:	<input type="text"/>		
	Crude Oils and JP4 Jet Fuels, Kerosenes, Solvents Gasolines and Naphthenes Lubricating Oils Diesel Oil, Heating Oils, Fuel Oils		
Report flags:	<input type="text"/>		



# SmartPlant Browser Module

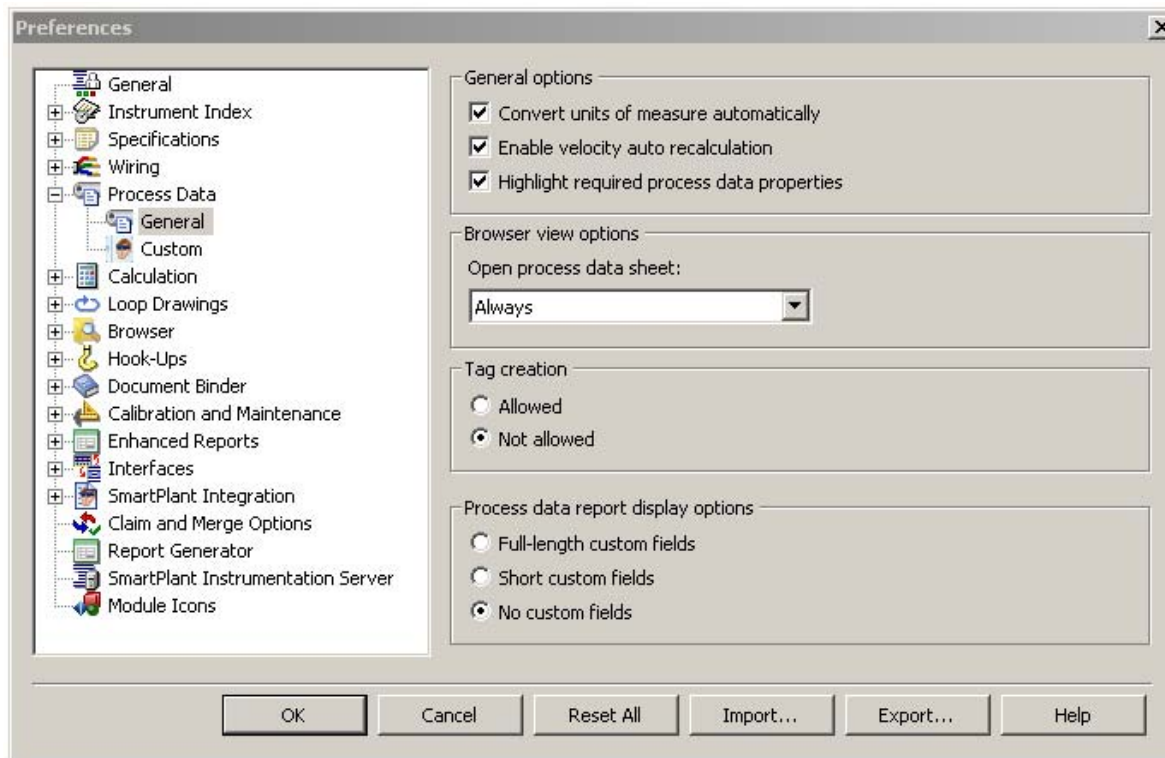
- ◆ All primary SmartPlant data tables are exposed for Browsing
- ◆ Allows users to create queries on Spec Sheets and Process Data
- ◆ Automatic Report and Export of query data from Browser





# Process Data User Preferences

- ◆ Open Process Data from Browsers
- ◆ Tag Creation NOT allowed from Process Module
- ◆ No Custom Fields results in better Process Data Reports





# Instrument Spec Module

- ◆ Instrument Specification
  - Form for each Spec Type
  - Edit Forms in SPI
  - Drop Down Data Windows
  - External Form Editor
  - Multi-Item forms
  - Multi-Sheet forms
  - Revision control
  - Show data from Index table
  - Link directly to Process Data
  - Export Specs to Excel or Intergraph External Editor

GENERAL	1	Tag No.	101-FV -100							
	2	Service	Feed from V-8							
	3	Line No.	4-2-1501-1104							
	4	Area Classification	Class 1, Division 2, Group C&D							
	5	Ambient Temperature:	Min.	Max.						
	6	Allowable Sound Pressure Level	dBA	90						
	7	Tightness Requirements	ANSI IV (standard)							
	8	Available Air Supply Pressure:	Min.	Max.						
	9	Power Failure Position	Close							
	10									
PIPE LINE	11	Line Size and Schedule	Inlet	Outlet	4	in	80	4"	80	
	12	Pipe Material	Carbon steel							
	13	Pipe Insulation	no							
PROCESS	14	Process Fluid	Lean Feed							
	15	Upstream Condition	Liquid							
	16	Differential Pressure	bar							
	17		Units	@ Max. Flow	@ Norm. Flow	@ Min. Flow				
	18	Flow Rate	Air/m	32	30	25				
	19	Inlet Pressure	bar-g	14	13	12				
	20	Pressure Drop	bar	3	8	8				
	21	Inlet Temperature	°C	150	150	150				
	22	Inlet Density / Specific Gravity / Molecular Mass	kg/m <sup>3</sup>	890	890	890				
	23	Inlet Compressibility Factor		—						
CONDITIONS	24	Inlet Viscosity	cP	0	0	0				
	25	Inlet Specific Heats Ratio		—						
	26	Inlet Vapour Pressure	bar-g	1	1	1				
	27									
CALCULATED RESULTS	28	Flow Coefficient Cv	—			20	13	10		
	29	Travel	%							
	30	Sound Pressure Level	dBA			65	69	78		
BODY AND TRIM	31	MFR	Model	Fisher	EZ					
	32	Body Type	Single Seat Globe							
	33	Body Size	Trim Size	2	in	By Mfr				
	34	Rated Or Characteristic	By Mfr	By Mfr						
	35	End Connec. & Rating	301 # RF							
	36	Body Material	CS							
	37	Bonnet Type / Material	Integral	SS						
	38	Flow Direction	By Mfr							
	39	Flow Action To	No							
	40	Lubricator / Isolat. Valve	No	No						
ACTUATOR	41	Acting	Nc. of Ports	By Mfr	1					
	42	Trim Type								
	43	Rated Travel								
	44	Plug / Ball / Disk Material	SS							
	45	Seat Material	SS							
	46	Cage	Stem Material SS							
	47	Gasket Material	By Mfr							
	48	MFR	Model	Fisher	BB7					
	49	Type	Diaphragm							
	50	Size	Area	By Mfr	By Mfr					
PURCHASE	51	Air Failure Valve:	Close							
	52	Handwheel Location	not required							
	53	Bandh Range	By Mfr							
	54									
	55									
	56	MFR	Model	By Mfr	By Mfr					
	57	Signal Inlet / Outlet	3-15 psig				By Mfr			
	58	Increase Signal Valve:	Open							
	59	Cam Characteristic	1/3							
	60	Bypass / Gauges	Yes				Yes			
61										
62										
63	MFR	Model								
64	Type									
65	When De-Energ Valve:									
66										
67	MFR	Model								
68	Type	Quantity								
69	Contacts / Rating									
70	Switching Position									
71										
72	MFR	Model	By Mfr	By Mfr						
73	Set Pressure	By Mfr								
74	Filter	Gauge				Yes				
75										
76	Hydro. Pressure									
77	Leakage									
78										
79	Manufacturer	FISHER								
80	Model	ES								
81	Purchase Order Num.	T.R.ESP.002/98								
82	Issue	Item Number				3250 8				
83	Serial Number									
Notes: 1. Valve to be supplied fully assembled, marked, with certificate										
INSTRUMENT SPECIFICATION										
Control Valve										
0	MS	11/22/1998	For bids							
No.	by	Date	Revision	Code: 1	Disp. No.	101-21-19901	Sheet 1	of 1	Rev.: 0	



# Spec Sheet Module

- ◆ Given proper rights – the process data may be edited from the Spec Sheets
  - Automatic Unit conversion does NOT work from Spec Sheets
  - Only selected process data is visible on Spec Sheets
  - Rights can be set to prohibit editing of process data from Spec Sheets
  - Multi case process data can be accessed on the Spec Sheet from the process Module
- ◆ **Editing Process Data From Spec Sheets is NOT Recommended**

PROCESS CONDITIONS	7	Fluid	Light Naphtha				
	8	Oper. Temperature	Max. Temperature	85	°C	85	°C
	9	Oper. Pressure	Max. Pressure	12	bar-g	12	bar-g
	10	Vibrations					
	11						



# Spec Sheet Module

- ◆ Type and number of Process variables available for Spec Sheets are different for each process function
  - ◆ Units of Measure (UID) are separated from the variable
  - ◆ Some Units of Measure are Computed fields
    - Pressure unit of measure psi-g is two fields
- if ( pd\_press\_uflg = 'G', rightTrim ( pd\_press\_uid ) + '-g', if ( pd\_press\_uflg = 'A' , rightTrim ( pd\_press\_uid ) + '-a', " ) )

PROCESS CONDITIONS	9	Fluid		pd_fluid_name			
	10	Pressure Max	Oper.	pd_press_max	if ( pd_press_uflg = 'G', rightTrim ( pd_press_uid ) + '-g', if ( pd_press_uflg = 'A' , rightTrim ( pd_press_uid ) + '-a', " ) )	pd_press_nor	if ( pd_press_uflg = 'G', rightTrim ( pd_press_uid ) + '-g', if ( pd_press_uflg = 'A' , rightTrim ( pd_press_uid ) + '-a', " ) )
	11	Temperature Max.	Oper.	pd_temp_max	pd_temp_uid	pd_temp_nor	pd_temp_uid
	12	Oper. Spec. Gravity	Oper. Viscosity	pd_spec_grav_nor		pd_visc_nor	pd_visc_uid
	13	spec_udf_c51		spec_udf_c07			
	14	spec_udf_c15		spec_udf_c16			

# Spec Sheet Module



## ◆ Different Process variables available for Process Function

Process Fluid	PD_FLUID_NAME
Max. Pressure	PD_PRESS_MAX
Oper. Pressure	PD_PRESS_NOR
Max. Temperature	PD_TEMP_MAX
Oper. Temperature	PD_TEMP_NOR
Temperature Unit Of Measure	PD_TEMP_UID
Process Vibrations	PD_VIBRATION

**TEMPERATURE**

# Spec Sheet Module



## ◆ Different Process variables available for Process Function

	Process Fluid	PD_FLUID_NAME
	Max. Pressure	PD_PRESS_MAX
Process F	Oper. Pressure	PD_PRESS_NOR
Max. Pres	Max. Temperature	PD_TEMP_MAX
Oper. Pre	Oper. Temperature	PD_TEMP_NOR
Max. Tem	Temperature Unit Of Measure	PD_TEMP_UID
Oper. Tem	Oper. Viscosity	PD_VISC_NOR
Temperatu	Viscosity Unit Of Measure	PD_VISC_UID
Process V	Max. Range	PD_P_RANGE_MAX
	Oper. Spec. Gravity	PD_SPEC_GRAV_NOR
	Calibration Range	PD_P_RANGE_MIN

**PRESSURE**



# Spec Sheet Module

## ◆ Different Process variables available for Process Function

	Reference Leg Fluid Density Level	PD_ABOVE_REF
	Density Upper	PD_DENS_NOR
	Density Unit Of Measure	PD_DENS_UID
Process F	Designed Temperature	PD_DESIGN_TEMP_MIN
Max. Pres	Temperature Unit Of Measure	PD_DESIGN_TEMP_UID
Oper. Pres	Fluid Upper	PD_FLUID_NAME
Max. Pres	Density Lower	PD_LOWER_DENSITY
Oper. Pres	Density Unit Of Measure	PD_LOWER_DENSITY_UID
Max. Temp	Fluid Lower	PD_LOWER_FLUID_NAME
Oper. Temp	Designed Pressure	PD_PRESS_DES
Temperature	Max. Pressure	PD_PRESS_MAX
Process V	Oper. Pressure	PD_PRESS_NOR
Max. Rang	Reference Line (Tangent / Center)	PD_REFERENCE
Oper. Spe	Max. Temperature	PD_TEMP_MAX
Calibration	Oper. Temperature	PD_TEMP_NOR
	Temperature Unit Of Measure	PD_TEMP_UID

**LEVEL**



# Spec Sheet Module

## ◆ Different Process variables available for Process Function

		Flow Full Scale	PD F_RANGE_MAX
		Max. Flow	PD FLOW_MAX
	Reference Leg	Min. Flow	PD FLOW_MIN
	Density Upper	Flow Operating	PD FLOW_NOR
	Density Unit O	Process Fluid	PD FLUID_NAME
	Designed Tem	Process State	PD FLUID_PHASE
Process F	Max. Pres	pd_gas_sg_as_mm	PD GAS_SG_AS_MM
Process F	Oper. Pres	pd_molecular_mass	PD MOLECULAR_MASS
Max. Pres	Max. Temp	Base Press.	PD_PRESS_BASE
Oper. Pres	Oper. Temp	Press Unit Of Measure	PD_PRESS_BASE_UID
Max. Temp	Temperatu	Max. Pressure	PD_PRESS_MAX
Oper. Temp	Oper. Visc	Oper. Pressure	PD_PRESS_NOR
Temperatu	Viscosity I	Spec. Gravity at Base	PD_SPEC_GRAV_BASE
Process V	Max. Rang	Oper. Gravity at Base	PD_SPEC_GRAV_NOR
	Oper. Spe	Base Temp	PD_TEMP_BASE
	Calibration	Temp Unit Of Measure	PD_TEMP_BASE_UID
		Max. Temperature	PD_TEMP_MAX
		Oper. Temperature	PD_TEMP_NOR
		Temperature Unit Of Measure	PD_TEMP_UID
		Viscosity at Operating Conditions	PD_VISC_NOR
		Viscosity Unit Id.	PD_VISC_UID

**FLOW**







# Spec Sheet Module

## ◆ Different Process variables available for Process Function

					% Allowable Overpressure	PD_ACCUMULATION
				Flow Full Scale	Conventional, Bellow, Pilot Operated	PD_CALC_CODE
			Reference Leg	Max. Flow	Compressibility Factor	PD_COMPRES_FLOW_NOR
		Density Upper		Min. Flow	Back Pressure Constant	PD_CONST_BACK_PRES
		Density Unit O		Flow Operating	Ratio of Specific Heats	PD_CP_CV_NOR
	Process F	Designed Tem		Process Fluid	Relief Density	PD_DENS_RELIEF
	Max. Pres	Temperature U		Process State	Dens Relief Unit Id	PD_DENS_RELIEF_UID
Process F	Oper. Pres	Fluid Upper	pd_gas_sg_as m	Process Fluid	Process Fluid	PD_FLUID_NAME
Max. Pres	Max. Temp	Density Lower	pd_molecular ma	Process State	Process State	PD_FLUID_PHASE
Oper. Pres	Oper. Tem	Density Unit O	Base Press.	Latent Heat of Vaporization	Latent Heat of Vaporization	PD_LATENT_HEAT_NOR
Max. Tem	Temperatu	Fluid Lower	Press Unit Of Me	Latent Heat Unit Id	Latent Heat Unit Id	PD_LATENT_HEAT_UID
Oper. Tem	Oper. Visc	Designed Pres	Max. Pressure	Body and Bonnet	Body and Bonnet	PD_MATERIAL
Temperatu	Viscosity I	Max. Pressure	Oper. Pressure	Required Capacity	Required Capacity	PD_MAX_DISCHARGE
Process V	Max. Rang	Oper. Pressure	Oper. Gravity at B	pd_molecular mass	pd_molecular mass	PD_MOLECULAR_MASS
	Oper. Spe	Reference Line	Base Temp	Oper. Pressure	Oper. Pressure	PD_PRESS_NOR
	Calibration	Max. Temperat	Temp Unit Of Me	RelievingTemperature	RelievingTemperature	PD_RELIEF_TEMP
		Oper. Tempera	Max. Temperature	Temperature Unit Of Measure	Temperature Unit Of Measure	PD_RELIEF_TEMP_UID
		Temperature U	Oper. Temperature	Oper. Temperature	Oper. Temperature	PD_TEMP_NOR
			Temperature Unit	Temperature Unit Of Measure	Temperature Unit Of Measure	PD_TEMP_UID
			Viscosity at Oper	Process Set Pressure	Process Set Pressure	PD_VAL_SET_PRES_MIN
			Viscosity Unit Id.	Back Pressure Variable	Back Pressure Variable	PD_VAR_BACK_PRES
				Relief Viscosity	Relief Viscosity	PD_VISC_RELIEF
				Viscosity Relief Unit Id	Viscosity Relief Unit Id	PD_VISC_RELIEF_UID

**RELIEF VALVE**



# Spec Sheet Module

## ◆ Different Process variables available for Process Function

Process F	Process Fluid
Max. Pres	Max. Pressure
Oper. Pres	Oper. Pressure
Max. Temp	Max. Temperature
Oper. Temp	Oper. Temperature
Max. Rang	Max. Range
Oper. Spe	Oper. Speed
Calibration	Calibration
Reference Leg	Reference Leg
Density Upper	Density Upper
Density Unit O	Density Unit O
Designed Tem	Designed Temperature
Temperature U	Temperature Upper
Fluid Upper	Fluid Upper
Density Lower	Density Lower
Density Unit O	Density Unit O
Fluid Lower	Fluid Lower
Designed Pres	Designed Pressure
Max. Pressure	Max. Pressure
Oper. Pressure	Oper. Pressure
Reference Line	Reference Line
Max. Temperat	Max. Temperature
Oper. Tempera	Oper. Temperature
Temperature U	Temperature Upper
Temperature U	Temperature Upper
Viscosity at Oper	Viscosity at Oper
Viscosity Unit Id.	Viscosity Unit Id.
Flow Full Scale	Flow Full Scale
Max. Flow	Max. Flow
Min. Flow	Min. Flow
Flow Operating	Flow Operating
Process Fluid	Process Fluid
Process State	Process State
pd_gas_sg_as m	pd_gas_sg_as m
pd_molecular ma	pd_molecular ma
Base Press.	Base Press.
Press Unit Of Me	Press Unit Of Me
Max. Pressure	Max. Pressure
Oper. Pressure	Oper. Pressure
Spec. Gravity at B	Spec. Gravity at B
Oper. Gravity at B	Oper. Gravity at B
Base Temp	Base Temp
Temp Unit Of Me	Temp Unit Of Me
Max. Temperature	Max. Temperature
Oper. Temperature	Oper. Temperature
Temperature Unit	Temperature Unit
Viscosity at Oper	Viscosity at Oper
Viscosity Unit Id.	Viscosity Unit Id.
% Allowable Overp	% Allowable Overp
Conventional, Bello	Conventional, Bello
Compressibility Fa	Compressibility Fa
Back Pressure Co	Back Pressure Co
Ratio of Specific H	Ratio of Specific H
Relief Density	Relief Density
Dens Relief Unit Id	Dens Relief Unit Id
Process Fluid	Process Fluid
Process State	Process State
Latent Heat of Vap	Latent Heat of Vap
Latent Heat Unit Id	Latent Heat Unit Id
Body and Bonnet	Body and Bonnet
Required Capacity	Required Capacity
pd_molecular mas	pd_molecular mas
Oper. Pressure	Oper. Pressure
Relieving Temperat	Relieving Temperat
Temperature Unit O	Temperature Unit O
Oper. Temperature	Oper. Temperature
Temperature Unit O	Temperature Unit O
Process Set Press	Process Set Press
Back Pressure Va	Back Pressure Va
Relief Viscosity	Relief Viscosity
Viscosity Relief Ur	Viscosity Relief Ur

pd_compres_flow_max	PD_COMPRES_FLOW_MAX
pd_compres_flow_min	PD_COMPRES_FLOW_MIN
pd_compres_flow_nor	PD_COMPRES_FLOW_NOR
pd_cp_cv_max	PD_CP_CV_MAX
pd_cp_cv_min	PD_CP_CV_MIN
pd_cp_cv_nor	PD_CP_CV_NOR
pd_dens_max	PD_DENS_MAX
pd_dens_min	PD_DENS_MIN
pd_dens_nor	PD_DENS_NOR
pd_dens_uid	PD_DENS_UID
Power Failure Position	PD_FAILURE_ACTION
Flow Rate@Max. Flow	PD_FLOW_MAX
Flow Rate@Min. Flow	PD_FLOW_MIN
Flow Rate@Norm. Flow	PD_FLOW_NOR
Process Fluid	PD_FLUID_NAME
Upstream Condition	PD_FLUID_PHASE
Differential Pressure	PD_MAX_SHUT_OFF_PRESS_DIF
Pressure Unit Of Measure	PD_MAX_SHUT_OFF_PRESS_DIF_UID
pd_molecular_mass	PD_MOLECULAR_MASS
Pressure Drop@Max. Flow	PD_PRESS_DRP_MAX
Pressure Drop@Min. Flow	PD_PRESS_DRP_MIN
Pressure Drop@Norm. Flow	PD_PRESS_DRP_NOR
Pressure Drop Units	PD_PRESS_DRP_UID
Inlet Pressure@Max. Flow	PD_PRESS_MAX
Inlet Pressure@Min. Flow	PD_PRESS_MIN
Inlet Pressure@Norm. Flow	PD_PRESS_NOR
Tightness Requirements	PD_SEAT_LEAK
pd_spec_grav_max	PD_SPEC_GRAV_MAX
pd_spec_grav_min	PD_SPEC_GRAV_MIN
pd_spec_grav_nor	PD_SPEC_GRAV_NOR
Inlet Temperature@Max. Flow	PD_TEMP_MAX
Inlet Temperature@Min. Flow	PD_TEMP_MIN
Inlet Temperature@Norm. Flow	PD_TEMP_NOR
Inlet Temperature Units	PD_TEMP_UID
Inlet Vapour Pressure@Max. Flow	PD_VAP_PRESS_MAX
Inlet Vapour Pressure@Min. Flow	PD_VAP_PRESS_MIN
Inlet Vapour Pressure@Norm. Flow	PD_VAP_PRESS_NOR
Inlet Viscosity@Max. Flow	PD_VISC_MAX
Inlet Viscosity@Min. Flow	PD_VISC_MIN
Inlet Viscosity@Norm. Flow	PD_VISC_NOR
Inlet Viscosity Units	PD_VISC_UID

**CONTROL VALVE**

# Spec Sheet Module

## ◆ Supplemented with Computed and Process Function Fields

Flow Rate Units	COMP_FLOW_UOM
Inlet Pressure Units	COMP_PRESS_UOM
Inlet Vapour Pressure Units	COMP_VAP_PRESS_UOM
No. of Ports	CV_NUM_PASSAGES
Sound Pressure Level@Max. Flow	CV_SOUND_LVL_MAX
Sound Pressure Level@Min. Flow	CV_SOUND_LVL_MIN
Sound Pressure Level@Norm. Flow	CV_SOUND_LVL_NOR
Travel@Max. Flow	CV_TRAVEL_MAX
Travel@Min. Flow	CV_TRAVEL_MIN
Travel@Norm. Flow	CV_TRAVEL_NOR
Body Size	CV_VALVE_DIAM
Size Unit Of Measure	CV_VALVE_DIAM_UID
Body Type	CV_VALVE_TYPE
Flow Coefficient Cv@Max. Flow	CV_VLV_CV_MAX
Flow Coefficient Cv@Min. Flow	CV_VLV_CV_MIN
Flow Coefficient Cv@Norm. Flow	CV_VLV_CV_NOR

pd_compres_flow_max	PD_COMPRES_FLOW_MAX
pd_compres_flow_min	PD_COMPRES_FLOW_MIN
pd_compres_flow_nor	PD_COMPRES_FLOW_NOR
pd_cp_cv_max	PD_CP_CV_MAX
pd_cp_cv_min	PD_CP_CV_MIN
pd_cp_cv_nor	PD_CP_CV_NOR
pd_dens_max	PD_DENS_MAX
pd_dens_min	PD_DENS_MIN
pd_dens_nor	PD_DENS_NOR
pd_dens_uid	PD_DENS_UID
Power Failure Position	PD_FAILURE_ACTION
Flow Rate@Max. Flow	PD_FLOW_MAX
Flow Rate@Min. Flow	PD_FLOW_MIN
Flow Rate@Norm. Flow	PD_FLOW_NOR
Process Fluid	PD_FLUID_NAME
Upstream Condition	PD_FLUID_PHASE
Differential Pressure	PD_MAX_SHUT_OFF_PRESS_DIF
Pressure Unit Of Measure	PD_MAX_SHUT_OFF_PRESS_DIF_UID
pd_molecular_mass	PD_MOLECULAR_MASS
Pressure Drop@Max. Flow	PD_PRESS_DRP_MAX
Pressure Drop@Min. Flow	PD_PRESS_DRP_MIN
Pressure Drop@Norm. Flow	PD_PRESS_DRP_NOR
Pressure Drop Units	PD_PRESS_DRP_UID
Pressure@Max. Flow	PD_PRESS_MAX
Pressure@Min. Flow	PD_PRESS_MIN
Pressure@Norm. Flow	PD_PRESS_NOR
Seal Leakage Requirements	PD_SEAT_LEAK
spec_grav_max	PD_SPEC_GRAV_MAX
spec_grav_min	PD_SPEC_GRAV_MIN
spec_grav_nor	PD_SPEC_GRAV_NOR
Temperature@Max. Flow	PD_TEMP_MAX
Temperature@Min. Flow	PD_TEMP_MIN
Temperature@Norm. Flow	PD_TEMP_NOR
Temperature Units	PD_TEMP_UID
Inlet Vapour Pressure@Max. Flow	PD_VAP_PRESS_MAX
Inlet Vapour Pressure@Min. Flow	PD_VAP_PRESS_MIN
Inlet Vapour Pressure@Norm. Flow	PD_VAP_PRESS_NOR
Inlet Viscosity@Max. Flow	PD_VISC_MAX
Inlet Viscosity@Min. Flow	PD_VISC_MIN
Inlet Viscosity@Norm. Flow	PD_VISC_NOR
Inlet Viscosity Units	PD_VISC_UID



# Instrument Calculation Module

- ◆ **Control Valve Sizing**
- ◆ **Relief Valve Sizing**
- ◆ **Flow Meter Sizing**
- ◆ **Thermowell Parameters**
  
- ◆ Uses excepted standard formulas
- ◆ Documents calculation basis
- ◆ Direct access to Process Data
- ◆ Generates Calculation Reports with Revisions

101-FV -100				
Feed from V-8				
CONTROL VALVE: Cv Calculation				
The Control Valve is sized according to ISA-75.01(1995)				
Hydrodynamic Noise is calculated according to Masoneilan OZ 3000E (1984)				
State: LIQUID				
FIND: Leak Feed				
	Unit	@ Min. Flow	@ Normal Flow	@ Max. Flow
Flow	m <sup>3</sup> /h	25	30	32
Upstream pressure	bar-g	12	13	14
Downstream pressure	bar-g	4	7	11
Differential pressure	bar	8	6	3
Temperature	°C	150	150	150
Specific gravity		0.890	0.890	0.890
Viscosity	cP	0.1	0.1	0.1
Vapour pressure	bar-g	0.9	0.9	0.9
Critical pressure	bar-g	1200		
Line size & Schedule: 4 in. sch 80				
Pipe inside diameter / Wall thickness: 3.825 / 3.825 / 0.337 in				
Valve diameter: 2 in				
Valve type: Single Globe				
Result and Coefficient		@ Min. Flow	@ Normal Flow	@ Max. Flow
Calculated Cv	(Cv)	9.88	13.5	20.4
Flow regime or condition		Incp.-Turb.	Turbulent	Turbulent
Valve Reynolds number	(Re)	5966731	5960334	5193193
Reynolds number factor	(F <sub>r</sub> )	1	1	1
Orifice pipe velocity	[m/s]	0.936	1.12	1.2
Hydrodynamic noise	[dB(A)]	77.9	69.4	65.1
Pressure recovery factor	(F <sub>p</sub> )	0.86	0.86	0.86
Pressure recovery factor	(F <sub>lp</sub> )	0.8575	0.8552	0.8491
Piping geometry factor	(F <sub>pg</sub> )	0.9974	0.995	0.9886
Critical pressure factor	(F <sub>cp</sub> )	0.9488	0.9488	0.9488
Cavitation index	(K <sub>c</sub> )	0.7207	0.4959	0.229
Valve cavitation index	(K <sub>cv</sub> )	0.5636	0.5636	0.5636
Max. allow. diff. pressure	[psid]	8.277	9.012	9.737
Valve style modifier	(F <sub>ds</sub> )	1		
Inlet lead coefficient	(K <sub>1</sub> )	1.189		
Total inlet lead coefficient	(ΣK <sub>1</sub> )	0.7922		
- Barometric Pressure: 1.00 atm @ sea level				
		CONTROL VALVE SIZING CALCULATION SHEET		INTERGRAPH Process & Building Solutions
0	MS	11/15/98	For piping	Sheet 1 of 1
No	By	Date	Revisor	Dwg. No.: 101-FV -100/CL
				Rev.: 0

# Process Data Issues



- ◆ Types of Process Data
  - Process Design Conditions
  - Process Operating Conditions
  - Process Ranges
  - Process Alarms and Trips
- ◆ Process Workflow needs to be different for Inline vs. Offline Devices
- ◆ Process Data Workflow may be circumvented using Process and Spec Browsers
- ◆ Process notes often required on Spec Sheet (create spec sheet notes page for Inline devices)

# Process Data in SmartPlant Instrumentation



- ◆ **Value Added by placing Process Data directly into SmartPlant Instrumentation:**
  - Timely Access to Process Data by Control Systems
  - Data Centric Control of Process Data
  - Management of Change
  - Real Process Data Becomes Deliverable

GENERAL						
Case name:	Case 1					
Tag number:	101-FE -100					
Service:	Feed from V-8	Location:	Line			
Fluid state:	Liquid	Line number:	4'-P-1501-11H			
Fluid phase:	Single phase	Line size:	4 in			
Fluid name:	Lean Feed	Line schedule:	80			
PROPERTIES						
	@Minimum	@Normal	@Maximum	Units		
Volumetric flow:	25	30	32	m <sup>3</sup> /h@flow		
Upstream pressure:	12	13	14	bar-g		
Temperature:	150	150	150	°C		
Viscosity:	0.1	0.1	0.1	cP		
Velocity:	0.936	1.12	1.2	m/s		
Density:	890	890	890	kg/m <sup>3</sup>		
Specific gravity:	0.891	0.891	0.891			
Compressibility:						
Vapour pressure:	0.9	0.9	0.9	bar-g		
Critical pressure:	1200			bar-g		
ADDITIONAL PROPERTIES						
Design pressure min:		bar-g		Corrosive:	No	
Design pressure max:	50	bar-g		Erosive:	No	
Design temperature min:		°C		Toxic:	No	
Design temperature max:	250	°C		Colored:		
Entrained gas:		%		Transparent:		
Required range:	From: 0		To: 36	m <sup>3</sup> /h@flow	Build-up tendency:	
Limits on press.drop across flowmeter:		mmH <sub>2</sub> O	4°C		Angle of repose:	
Check Out						
BASE CONDITIONS						
Pressure:	1	bar-a		Density:	kg/m <sup>3</sup>	
Temperature:	15.5	°C		Specific gravity:		
				Compressibility:		
ALARM						
Low-Low-Low:	Alarm	Trip		Engineering units:	m <sup>3</sup> /h@flow	
Low-Low:						
Low:						
High:						
High-High:						
High-High-High:						
Shutdown Code						
API 2540 STANDARD						
USER DEFINED FIELD						
NOTE						
				FLOW PROCESS DATA SHEET	INTERGRAPH	
				Domain: DEMO	Process - Power - Offshore	
g	MS	11/19/1998	For instrumentation	Date: 4/13/2004	Sheet 1	Of 1
No.	By	Date	Description	Drawing number: 101-FE -100-PD		Rev: 0



## Best Practice

Process Data directly into SmartPlant Instrumentation

Questions?