

Ranges, Alarms and Trips in Smart Instrumentation



**WHAT RANGES, ALARMS AND TRIPS
BELONG IN SMART INSTRUMENTATION?**

FLUOR[®]

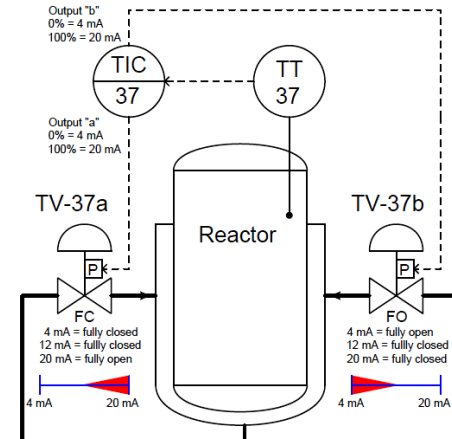
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Fluor SI SME

Issues with Ranges in Smart Instrumentation

- Most Ranges are defined and entered based on the Process Functions in SI
- Users creating UDFs for Ranges to combine multiple range fields into one data field
- Ranges are not shown on P&IDs and when they are they are usually a percentage of the signal or elevation for level on a tank or vessel

A	B	C	D
Tag_ID Number	Calibrated Range	Span	Output Range
LT -860272	97.379997-37.38 in	- inH2O	0-100 %
LT -860273	97.379997-37.38 in	-250-250 inH2O	0-100 %
LT -860283	97.379997-37.38 in	- inH2O	0-100 %
LT -860284	97.379997-37.38 in	- inH2O	0-100 %
LT -860297	356.625-32.625 in	-	0-100 %
LT -860298	368-44 in	-	0-100 %
LT -860307	85.379997-37.38 in	- inH2O	0-100 %
LT -860308	85.379997-37.38 in	- inH2O	0-100 %
LT -860317	87.379997-39.38 in	- inH2O	0-100 %
LT -860318	87.379997-39.38 in	- inH2O	0-100 %
LT -860381	132-21.25 in	-	0-100 %
LT -860391	116-21.25 in	-	0-100 %
LT -860752	-250-250 inH2O	-250-250 inH2O	0-100 %
LT -860764	-250-250 inH2O	-250-250 inH2O	0-100 %

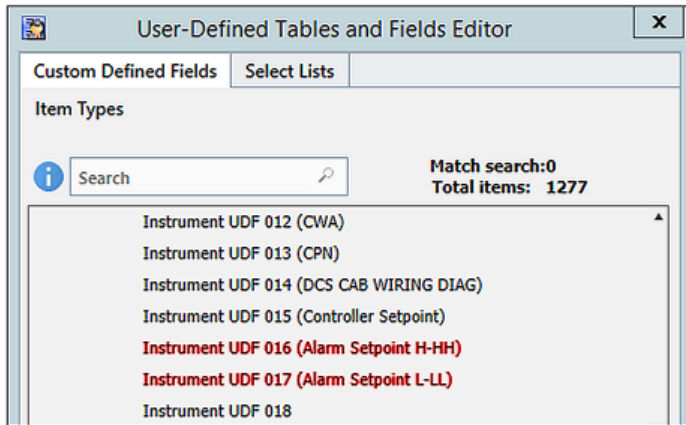
Combined Range UDF



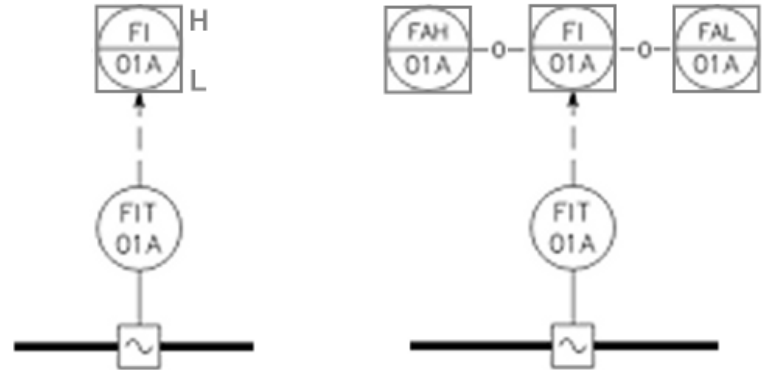
Ranges as shown on P&ID

Issues with Alarms in Smart Instrumentation

- Alarms are typically in HMI of the DCS system and programmed by the DCS configuration
- Alarm set points in SI must match the DCS set points since the same data in two places
- Users creating UDFs for Alarms that are already defined in the SI data dictionary
- Alarms not shown per ANSI/ISA 5.1 on P&IDs results in no records in P&ID database



User Created Alarm UDF



Not ISA or PIP Symbol ISA and PIP Alarm Symbol

Instrumentation and CS Tag Number Ranges

- Ranges associated to the Instrument or CS Tag Name are available from any Instrument or Control Systems Tag EDE View
 - Calibration Ranges are normally factory bench calibration settings
 - DCS Range is the predicted DCS configuration settings
 - Instrument Ranges are provided for vendor Sizing and Selection

SI DATABASE FIELD NAME	EDE PROPERTY DESCRIPTION
CALIB_RANGE_MAX	Calibration Range Maximum
CALIB_RANGE_UOM_MAX	Calibration Range Maximum Units
CALIB_RANGE_UFLG_MAX	Calibration Range Maximum Units Flag
CALIB_RANGE_MIN	Calibration Range Minimum
CALIB_RANGE_UOM_MIN	Calibration Range Minimum Units
CALIB_RANGE_UFLG_MIN	Calibration Range Minimum Units Flag
DCS_RANGE_MAX	DCS Range Maximum
DCS_RANGE_MIN	DCS Range Minimum
DCS_RANGE_UOM	DCS Range Maximum Units
DCS_RANGE_UFLG	DCS Range Maximum Units Flag
INST_RANGE_MAX	Instrument Range Maximum
INST_RANGE_UOM_MAX	Instrument Range Maximum Units
INST_RANGE_UFLG_MAX	Instrument Range Maximum Units Flag
INST_RANGE_MIN	Instrument Range Minimum
INST_RANGE_UOM_MIN	Instrument Range Minimum Units
INST_RANGE_UFLG_MIN	Instrument Range Minimum Units Flag

Control Systems Tag Number Alarms and Trips

- Alarm and Trips associated to the Control Systems Tag Name are available from the Control Systems Tag EDE View
 - Six Calibration Alarm / Trip Settings are available for Hi, HiHi, HiHiHi, Lo, LoLo, LO LO LO
 - Control System Alarm are passed through the DCS I/O loading

DATABASE FIELD NAME	CONTROL SYSTEM PROPERTY DESCRIPTION
CALIBRATION_SETTING.TRIP_SET_DESC	1st thru 6th Alarm / Trip Point Description
CALIBRATION_SETTING.TRIP_SET_DIR	1st thru 6th Alarm / Trip Point Direction
CALIBRATION_SETTING.TRIP_SET_MAX	1st thru 6th Alarm / Trip Point Max Value
CALIBRATION_SETTING.TRIP_SET_MIN	1st thru 6th Alarm / Trip Point Min Value
CALIBRATION_SETTING.TRIP_SET_VALUE	1st thru 6th Alarm / Trip Point Type
CALIBRATION_SETTING.TRIP_SET_POINT	1st thru 6th Alarm / Trip Point Value
CALIBRATION_SETTING.TRIP_SET_UOM	1st thru 6th Alarm / Trip Unit of Measure
CALIBRATION_SETTING.TRIP_SET_UOM_UFLG	1st thru 6th Alarm / Trip Unit of Measure Flag
ALARM_HIGH	Control SystemTag Alarm High
ALARM_HIGH_HIGH	Control SystemTag Alarm High-High
ALARM_LOW	Control SystemTag Alarm Low
ALARM_LOW_LOW	Control SystemTag Alarm Low-Low
ALARM_UOM_CODE	Control SystemTag Alarm Unit of Measure Code

Process Instrument Design Data Conditions

- Process Design Conditions are established from the Piping Line Class Spec or Equipment Trim
 - Design Conditions represent the most severe conditions that the Instrument can be exposed to
 - ASME B31.3 requires all Process Values fall within these ranges

DESIGN CONDITION FIELD NAME	DESIGN CONDITION DESCRIPTION
PD_PRESS_DES	Design Pressure Maximum
PD_PRESS_DES_MIN	Design Pressure Minimum
PD_PRESS_DES_MIN_FLG	Design Pressure Minimum Unit of Measure Flag
PD_PRESS_DES_MIN_UID	Design Pressure Minimum Unit of Measure
PD_PRESS_DES_UFLG	Design Pressure Maximum Unit of Measure Flag
PD_PRESS_DES_UID	Design Pressure Maximum Unit of Measure
PD_RETURN_PRES_DESIGN	Design Return Pressure
PD_RETURN_PRES_DESIGN_UFLG	Design Return Pressure (Gage / Absolute)
PD_RETURN_PRES_DESIGN_UID	Design Return Pressure Unit of Measure
PD_RETURN_TEMP_DESIGN	Design Return Temperature
PD_DESIGN_TEMP_MAX	Design Temperature Maximum
PD_DESIGN_TEMP_MIN	Design Temperature Minimum
PD_DESIGN_TEMP_UID	Design Temperature Unit of Measure

Process Data General and Base Ambient Ranges

- Process Data Ambient Ranges are available in the General Process Data EDE View
 - Base Pressure and Temperature are set in the Units of Measure and Accuracy
 - Process Pressure and Temperature ranges can have additional properties (e.g. Inlet, Outlet, Differential, etc.)

PROCESS DATA BASE FIELD NAME	GENERAL PROPERTY DESCRIPTION
PD_PRESS_BASE	Base Pressure
PD_PRESS_BASE_UID	Base Pressure Unit of Measure
PD_PRESS_MAX	Pressure Maximum
PD_PRESS_MIN	Pressure Minimum
PD_PRESS_NOR	Pressure (at Normal)
PD_PRESS_UFLG	Pressure (Gage / Absolute)
PD_PRESS_UID	Pressure Unit of Measure
PD_TEMP_BASE	Base Temperature
PD_TEMP_BASE_UID	Base Temperature Unit of Measure
PD_TEMP_MAX	Temperature Maximum
PD_TEMP_MIN	Temperature Minimum
PD_TEMP_NOR	Temperature (at Normal)
PD_TEMP_UID	Temperature Unit of Measure

Process Analyzer Alarm and Trips

- Analyzer Alarms and trips are technically Stream data not Process Data
 - Alarms and Trips are a percentage of whatever stream material the analyzer is measuring
- EDE access Analyzer Alarm and Trip properties is from any Analyzer View – Process Data – Analyzer – Alarms&Trips

PROCESS ANALYZER FIELD NAME	ANALYZER PROPERTY DESCRIPTION
ANALYZER.PD_A_ALARM_HIGH	Analyzer Alarm High Setting
ANALYZER.PD_A_ALARM_HIGH_HIGH	Analyzer Alarm High-High Setting
ANALYZER.PD_A_ALARM_HIGH_HIGH_HIGH	Analyzer Alarm High-High-High Setting
ANALYZER.PD_A_ALARM_LOW	Analyzer Alarm Low Setting
ANALYZER.PD_A_ALARM_LOW_LOW	Analyzer Alarm Low-Low Setting
ANALYZER.PD_A_ALARM_LOW_LOW_LOW	Analyzer Alarm Low-Low-Low Setting
ANALYZER.PD_A_TRIP_ALARM_UFLG	Analyzer Alarm / Trip (A / B / C)
ANALYZER.PD_A_TRIP_ALARM_UID	Analyzer Alarm / Trip Unit of Measure
ANALYZER.PD_A_TRIP_HIGH	Analyzer Trip High Setting
ANALYZER.PD_A_TRIP_HIGH_HIGH	Analyzer Trip High-High Setting
ANALYZER.PD_A_TRIP_HIGH_HIGH_HIGH	Analyzer Trip High-High-High Setting
ANALYZER.PD_A_TRIP_LOW	Analyzer Trip Low Setting
ANALYZER.PD_A_TRIP_LOW_LOW	Analyzer Trip Low-Low Setting
ANALYZER.PD_A_TRIP_LOW_LOW_LOW	Analyzer Trip Low-Low-Low Setting

Process Flow Ranges, Alarm and Trips

- Flow ranges are defined by the Process Engineers based on their Material balances
- EDE Flowmeter Alarm and Trip properties are unique to Flow and accessible via Process Data – Flow / Alarms&Trips
- Note the three levels of Alarm and Trips High and Low settings

PROCESS FLOW FIELD NAME	PROCESS FLOW PROPERTY DESCRIPTION
FLOW.PD_F_RANGE_MAX	Flow Range Maximum
FLOW.PD_F_RANGE_MIN	Flow Range Minimum
FLOW.PD_F_RANGE_UFLG	Flow Range Unit of Measure Flag
FLOW.PD_F_RANGE_UID	Flow Range Unit of Measure
FLOW.PD_F_ALARM_HIGH	Flowmeter Alarm High Setting
FLOW.PD_F_ALARM_HIGH_HIGH	Flowmeter Alarm High-High Setting
FLOW.PD_F_ALARM_HIGH_HIGH_HIGH	Flowmeter Alarm High-High-High Setting
FLOW.PD_F_ALARM_LOW	Flowmeter Alarm Low Setting
FLOW.PD_F_ALARM_LOW_LOW	Flowmeter Alarm Low-Low Setting
FLOW.PD_F_ALARM_LOW_LOW_LOW	Flowmeter Alarm Low-Low-Low Setting
FLOW.PD_F_TRIP_ALARM_UFLG	Flowmeter Alarm / Trip (Flow / Normal / Standard / Base)
FLOW.PD_F_TRIP_ALARM_UID	Flowmeter Alarm / Trip Unit of Measure
FLOW.PD_F_TRIP_HIGH	Flowmeter Trip High Setting
FLOW.PD_F_TRIP_HIGH_HIGH	Flowmeter Trip High-High Setting
FLOW.PD_F_TRIP_HIGH_HIGH_HIGH	Flowmeter Trip High-High-High Setting
FLOW.PD_F_TRIP_LOW	Flowmeter Trip Low Setting
FLOW.PD_F_TRIP_LOW_LOW	Flowmeter Trip Low-Low Setting
FLOW.PD_F_TRIP_LOW_LOW_LOW	Flowmeter Trip Low-Low-Low Setting

Process Level Ranges, Alarm and Trips

- Level ranges are defined by the Process Engineers based on their Material balances
- EDE Level Alarm and Trip properties are unique to Level and accessible via Process Data – Level / Alarms&Trips
- Note the three levels of Alarm and Trips High and Low settings

PROCESS LEVEL FIELD NAME	PROCESS LEVEL PROPERTY DESCRIPTION
LEVEL_INSTRUMENT.PD_L_RANGE_MAX	Level Range Maximum
LEVEL_INSTRUMENT.PD_L_RANGE_MIN	Level Range Minimum
LEVEL_INSTRUMENT.PD_L_RANGE_UID	Level Range Unit of Measure
LEVEL_INSTRUMENT.PD_L_ALARM_HIGH	Level Instrument Alarm High Setting
LEVEL_INSTRUMENT.PD_L_ALARM_HIGH_HIGH	Level Instrument Alarm High-High Setting
LEVEL_INSTRUMENT.PD_L_ALARM_HIGH_HIGH_HIGH	Level Instrument Alarm High-High-High Setting
LEVEL_INSTRUMENT.PD_L_ALARM_LOW	Level Instrument Alarm Low Setting
LEVEL_INSTRUMENT.PD_L_ALARM_LOW_LOW	Level Instrument Alarm Low-Low Setting
LEVEL_INSTRUMENT.PD_L_ALARM_LOW_LOW_LOW	Level Instrument Alarm Low-Low-Low Setting
LEVEL_INSTRUMENT.PD_L_TRIP_ALARM_UID	Level Instrument Alarm / Trip Unit of Measure
LEVEL_INSTRUMENT.PD_L_TRIP_HIGH	Level Instrument Trip High Setting
LEVEL_INSTRUMENT.PD_L_TRIP_HIGH_HIGH	Level Instrument Trip High-High Setting
LEVEL_INSTRUMENT.PD_L_TRIP_HIGH_HIGH_HIGH	Level Instrument Trip High-High-High Setting
LEVEL_INSTRUMENT.PD_L_TRIP_LOW	Level Instrument Trip Low Setting
LEVEL_INSTRUMENT.PD_L_TRIP_LOW_LOW	Level Instrument Trip Low-Low Setting
LEVEL_INSTRUMENT.PD_L_TRIP_LOW_LOW_LOW	Level Instrument Trip Low-Low-Low Setting

Process Pressure Ranges, Alarm and Trips

- Pressure ranges are defined by the Process Engineers based on their Material balances
- EDE Pressure Alarm and Trip properties are unique to Pressure and accessible via Process Data – Pressure / Alarms&Trips
- Note the Unit of Measure Flag (Gage / Absolute) adds an additional field to the Unit of Measure

PROCESS PRESSURE FIELD NAME	PROCESS PRESSURE PROPERTY DESCRIPTION
PRESSURE.PD_P_RANGE_MAX	Pressure Range Maximum
PRESSURE.PD_P_RANGE_MIN	Pressure Range Minimum
PRESSURE.PD_P_RANGE_UFLG	Pressure Range Unit of Measure Flag (Gage / Absolute)
PRESSURE.PD_P_RANGE_UID	Pressure Range Unit of Measure
PRESSURE.PD_P_ALARM_HIGH	Pressure Instrument Alarm High Setting
PRESSURE.PD_P_ALARM_HIGH_HIGH	Pressure Instrument Alarm High-High Setting
PRESSURE.PD_P_ALARM_HIGH_HIGH_HIGH	Pressure Instrument Alarm High-High-High Setting
PRESSURE.PD_P_ALARM_LOW	Pressure Instrument Alarm Low Setting
PRESSURE.PD_P_ALARM_LOW_LOW	Pressure Instrument Alarm Low-Low Setting
PRESSURE.PD_P_ALARM_LOW_LOW_LOW	Pressure Instrument Alarm Low-Low-Low Setting
PRESSURE.PD_P_TRIP_HIGH	Pressure Instrument Trip High Setting
PRESSURE.PD_P_TRIP_HIGH_HIGH	Pressure Instrument Trip High-High Setting
PRESSURE.PD_P_TRIP_HIGH_HIGH_HIGH	Pressure Instrument Trip High-High-High Setting
PRESSURE.PD_P_TRIP_LOW	Pressure Instrument Trip Low Setting
PRESSURE.PD_P_TRIP_LOW_LOW	Pressure Instrument Trip Low-Low Setting
PRESSURE.PD_P_TRIP_LOW_LOW_LOW	Pressure Instrument Trip Low-Low-Low Setting
PRESSURE.PD_P_TRIP_ALARM_UFLG	Pressure Instrument Alarm / Trip (Gage / Absolute)
PRESSURE.PD_P_TRIP_ALARM_UID	Pressure Instrument Alarm / Trip Unit of Measure

Process Relief Valve Ranges, Alarm and Trips

- Relief Valve ranges are set in accordance with API Standard 521/ISO 23251 Sect. 4
- EDE Relief Valve Alarm and Trip properties are unique to Relief Valve and accessible via Process Data – Relief Valve / Alarms&Trips
- Note that both the Pressure and Temperature are considered with the Relief Valve Ranges

PROCESS RELIEF VALVE FIELD NAME	RELIEF VALVE PROPERTY DESCRIPTION
RELIEF_VALVE.PD_MAX_PRES_MAX	Pressure Maximum Relief Valve
RELIEF_VALVE.PD_MAX_PRES_MIN	Pressure Minimum Relief Valve
RELIEF_VALVE.PD_MAX_PRES_UFLG	Relief Valve Pressure (Gage / Absolute)
RELIEF_VALVE.PD_MAX_PRES_UID	Relief Valve Pressure Unit of Measure
RELIEF_VALVE.PD_RELIEF_TEMP	Relief Valve Temperature
RELIEF_VALVE.PD_RELIEF_TEMP_UID	Relief Valve Temperature Unit of Measure
RELIEF_VALVE.PD_R_ALARM_HIGH	Relief Valve Alarm High Setting
RELIEF_VALVE.PD_R_ALARM_HIGH_HIGH	Relief Valve Alarm High-High Setting
RELIEF_VALVE.PD_R_ALARM_LOW	Relief Valve Alarm Low Setting
RELIEF_VALVE.PD_R_ALARM_LOW_LOW	Relief Valve Alarm Low-Low Setting
RELIEF_VALVE.PD_R_TRIP_ALARM_UID	Relief Valve Alarm / Trip Unit of Measure
RELIEF_VALVE.PD_R_TRIP_HIGH	Relief Valve Trip High Setting
RELIEF_VALVE.PD_R_TRIP_HIGH_HIGH	Relief Valve Trip High-High Setting
RELIEF_VALVE.PD_R_TRIP_LOW	Relief Valve Trip Low Setting
RELIEF_VALVE.PD_R_TRIP_LOW_LOW	Relief Valve Trip Low-Low Setting

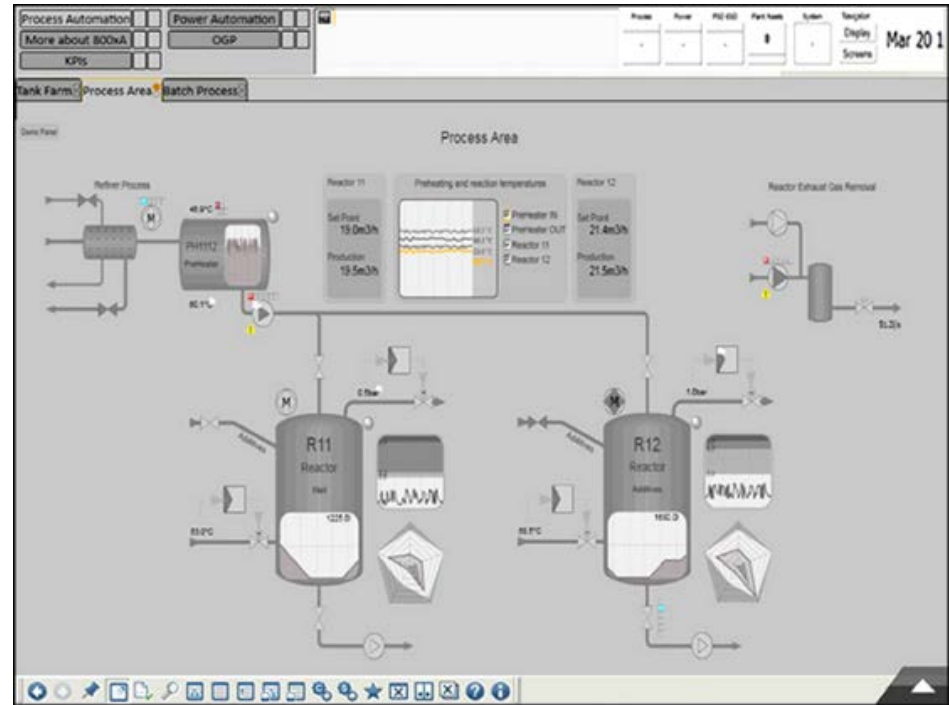
Process Temperature Ranges, Alarm and Trips

- Temperature ranges defined by the Process Engineers based on their Material balances
- EDE Temperature Alarm and Trip properties are unique to Temperature accessible via Process Data –Temperature / Alarms&Trips
- Note the three levels of Alarm and Trips High and Low settings

PROCESS TEMPERATURE FIELD NAME	TEMPERATURE PROPERTY DESCRIPTION
TEMPERATURE.PD_T_RANGE_MAX	Temperature Range Maximum
TEMPERATURE.PD_T_RANGE_MIN	Temperature Range Minimum
TEMPERATURE.PD_T_RANGE_UID	Temperature Range Unit of Measure
TEMPERATURE.PD_T_ALARM_HIGH	Temperature Alarm High Setting
TEMPERATURE.PD_T_ALARM_HIGH_HIGH	Temperature Alarm High-High Setting
TEMPERATURE.PD_T_ALARM_HIGH_HIGH_HIGH	Temperature Alarm High-High-High Setting
TEMPERATURE.PD_T_ALARM_LOW	Temperature Alarm Low Setting
TEMPERATURE.PD_T_ALARM_LOW_LOW	Temperature Alarm Low-Low Setting
TEMPERATURE.PD_T_ALARM_LOW_LOW_LOW	Temperature Alarm Low-Low-Low Setting
TEMPERATURE.PD_T_TRIP_ALARM_UID	Temperature Alarm / Trip Unit of Measure
TEMPERATURE.PD_T_TRIP_HIGH	Temperature Trip High Setting
TEMPERATURE.PD_T_TRIP_HIGH_HIGH	Temperature Trip High-High Setting
TEMPERATURE.PD_T_TRIP_HIGH_HIGH_HIGH	Temperature Trip High-High-High Setting
TEMPERATURE.PD_T_TRIP_LOW	Temperature Trip Low Setting
TEMPERATURE.PD_T_TRIP_LOW_LOW	Temperature Trip Low-Low Setting
TEMPERATURE.PD_T_TRIP_LOW_LOW_LOW	Temperature Trip Low-Low-Low Setting

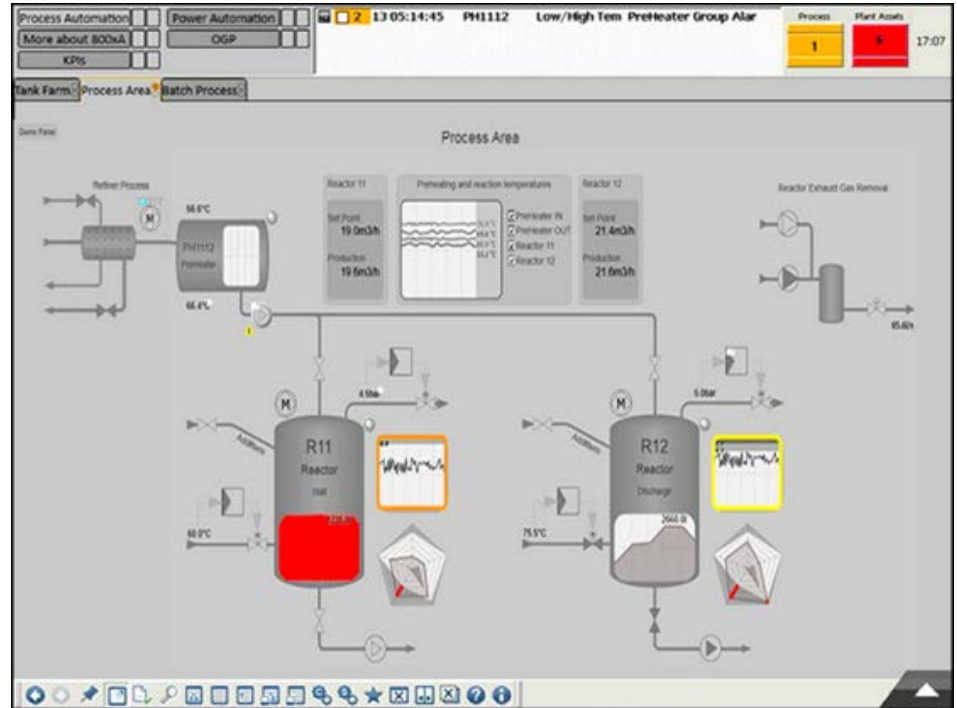
Ranges in Smart Instrumentation

- Process Operating Ranges in SI are defined in the Process Module and are needed for Instrument Sizing and Selection
- Instrument Ranges can be included on Spec Sheets for Vendor Sizing
- Calibration Ranges in SI are for Owner Operators to Maintain Instruments
- DCS Ranges in SI can be passed to DCS Vendors via I/O loading for initial configuration



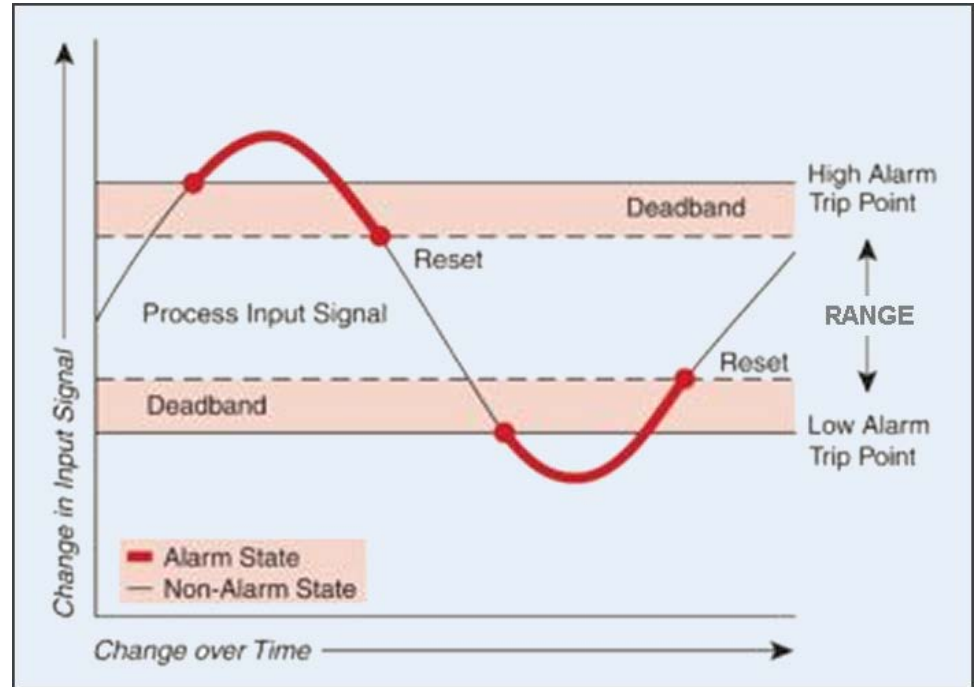
Alarm and Trips in Smart Instrumentation

- Smart Instrumentation is designed to document HARD (field) tags and does not handle SOFT tags well
- DCS Alarm set points are configured as HMI SOFT tags
- DCS Trip set points are shown as SOFT interlocks configured as DCS outputs to SI defined HARD tags
- SIS Alarms and Trips differ from DCS as they are usually HARD field switches that are inputs or logic solver outputs to SI defined HARD tags



Smart Instrumentation Ranges, Alarm and Trips

- There are enough Range, Alarms and Trip fields in Smart Instrumentation, so users do not need to define UDFs
- All Range, Alarms and Trip fields are available and editable in EDE views
- Soft Range, Alarms and Trips are not normally documented in Smart Instrumentation
- Hard Range, Alarms and Trips should be documented in Smart Instrumentation



Stay Well Everyone!



“Speak of change, and the world is in ALARM!

And yet where do we not see change?”

~ Frances Wright