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The Power of Data

THRIVING IN A WORLD OF CHANGE

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Power Plant Startup Monitoring and Optimization

Presented by **Steve Winsett, Entergy OIS Program Manager**

Entergy
THE POWER OF PEOPLE

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Entergy's PI Solutions

Plant Real-time Monitoring & Diagnostics

Unit Optimization & Equipment Monitors
• 16 plants •

OIS w/ EtaPRO™
PI system

Event Detection & Alerting
• 22 plants •

PI system
eCM™

Mobile Performance Testing
• 5 support offices •

Incremental Heat Rate / Equipment Tests
PI system

Fleet Optimization
• 22 plants •

Fleet Processes & Metrics
PI system

Dispatch Support, Fuel Telemetry
PI system

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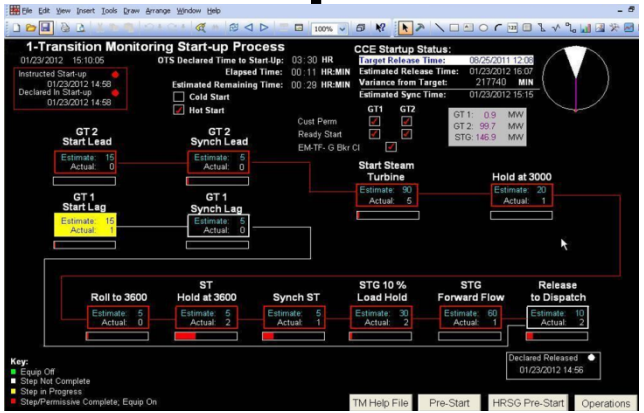
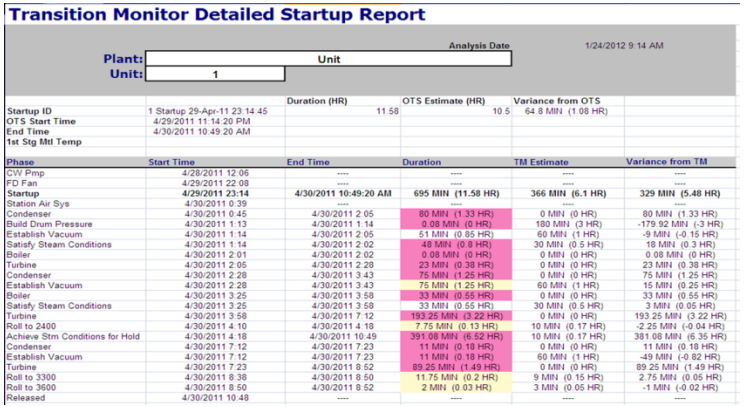
Startup Challenge: How to Improve?





Business Challenges

- Startups for each unit were occasional and inconsistent
- Personnel can be shared plant-to-plant
- Aging workforce/new employees

Solution

- Implemented series of PI Processbook displays
- Using PI Batch, created Batches to track startups and times
- Developed reporting spreadsheet using the PI-SDK

Results

- Startups easier to track outside of plant
- More procedurally consistent startups
- Startup accuracy improved by roughly 95%

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PI Products Used – Straight Out of the Box!

PI ProcessBook & Performance Equations:

- Determine/display start-up progress
- Accumulate actual elapsed time
- Calculate “% complete”
- Track status of plant equipment & conditions

PI Batch:

- “Back-bone” of the start-up monitor
- Facilitates reporting

PI Manual Logger (Future):

- To capture water analysis from grab samples during start-up

PI-DataLink/PI-SDK:

- Start-up Reports

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Needs for a Successful Startup Monitoring Project

PI-Processbook

- Graphically illustrate the start-up process
- Track progress
  - Durations, milestones, “time remaining”

- Link to operating procedures
- Display key process data
- “Replay” startups for process improvement

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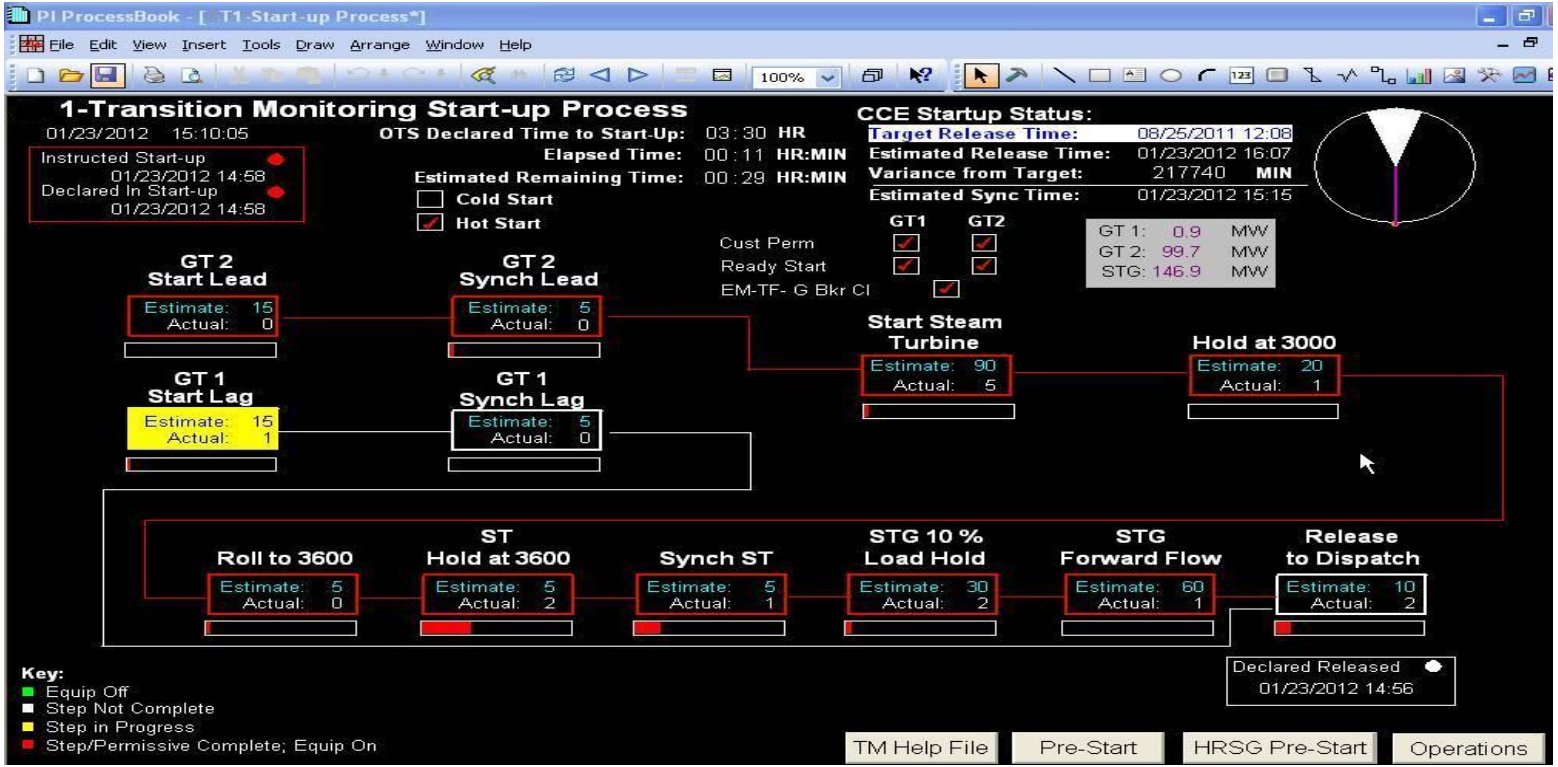
New PI Solution: Transition Monitor



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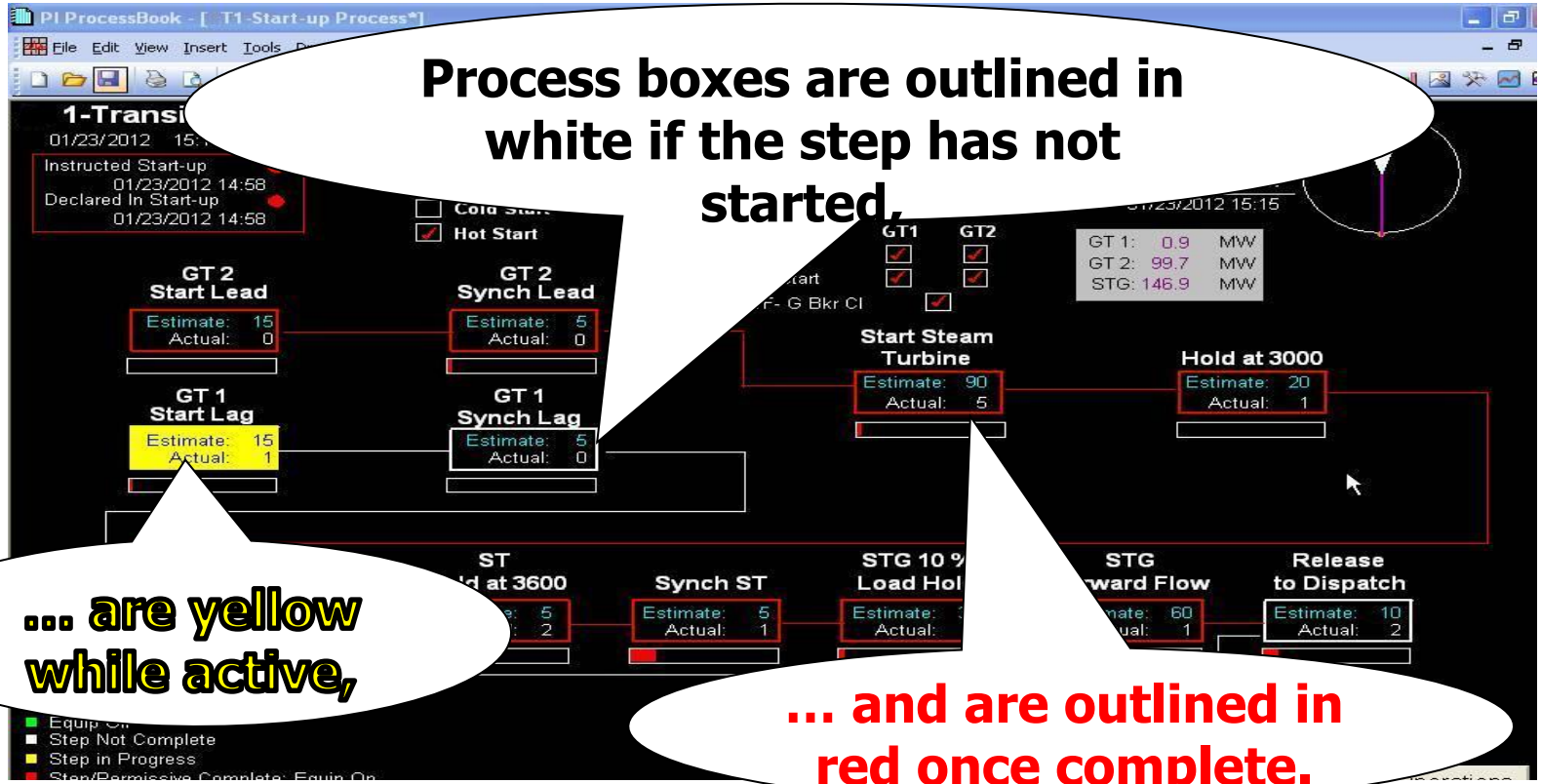
New PI Solution: Transition Monitor



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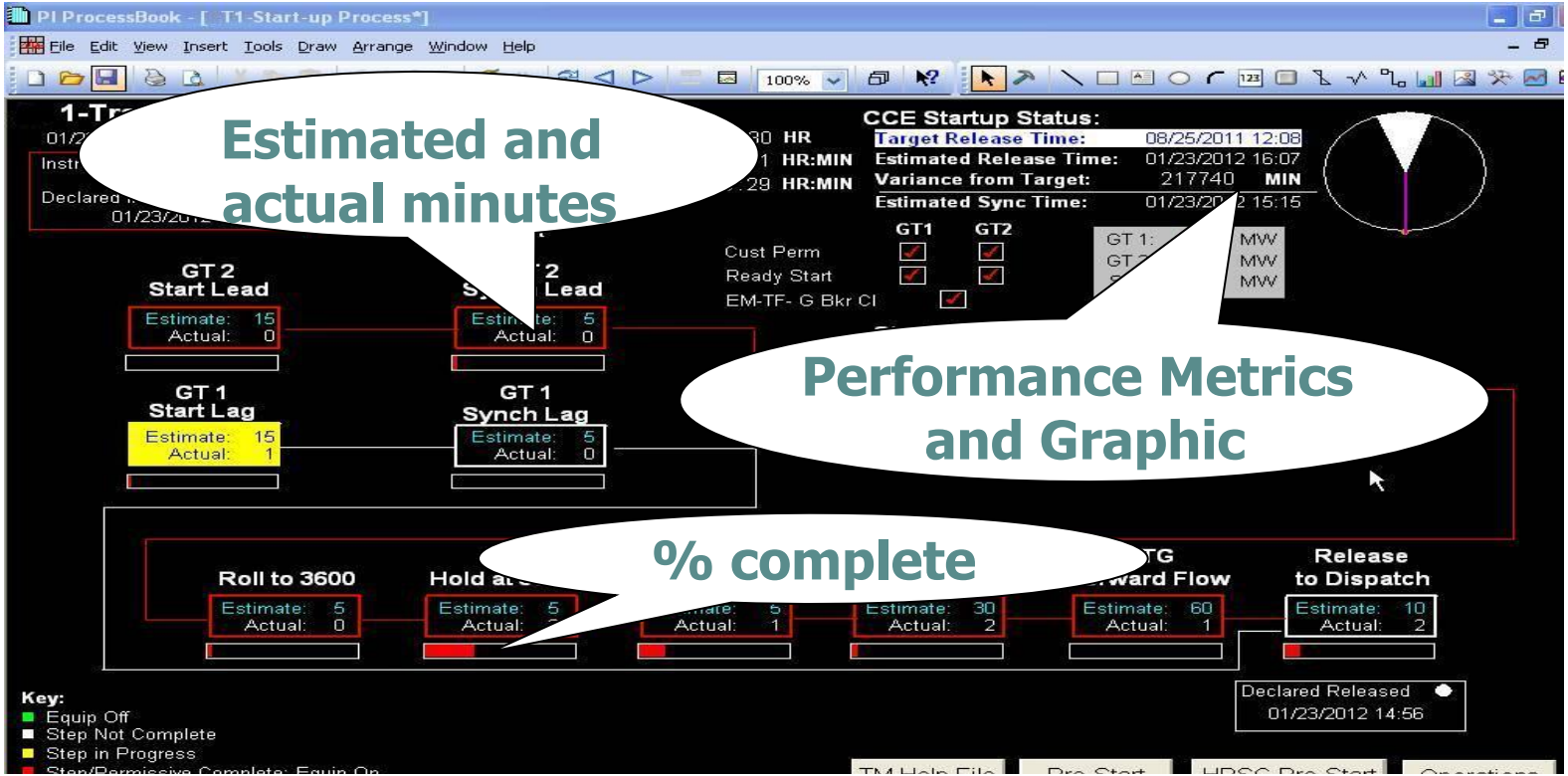
New PI Solution: Transition Monitor



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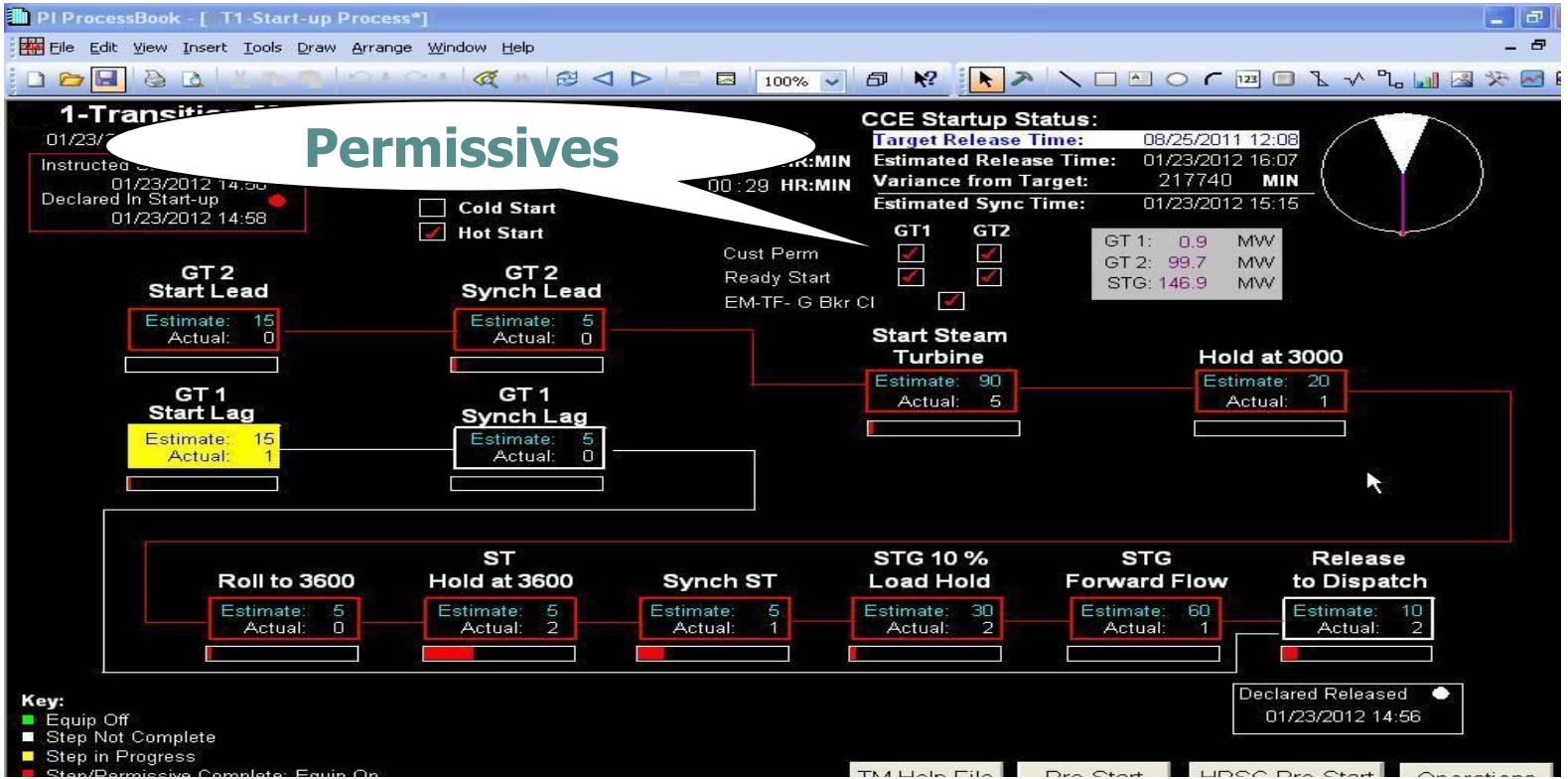

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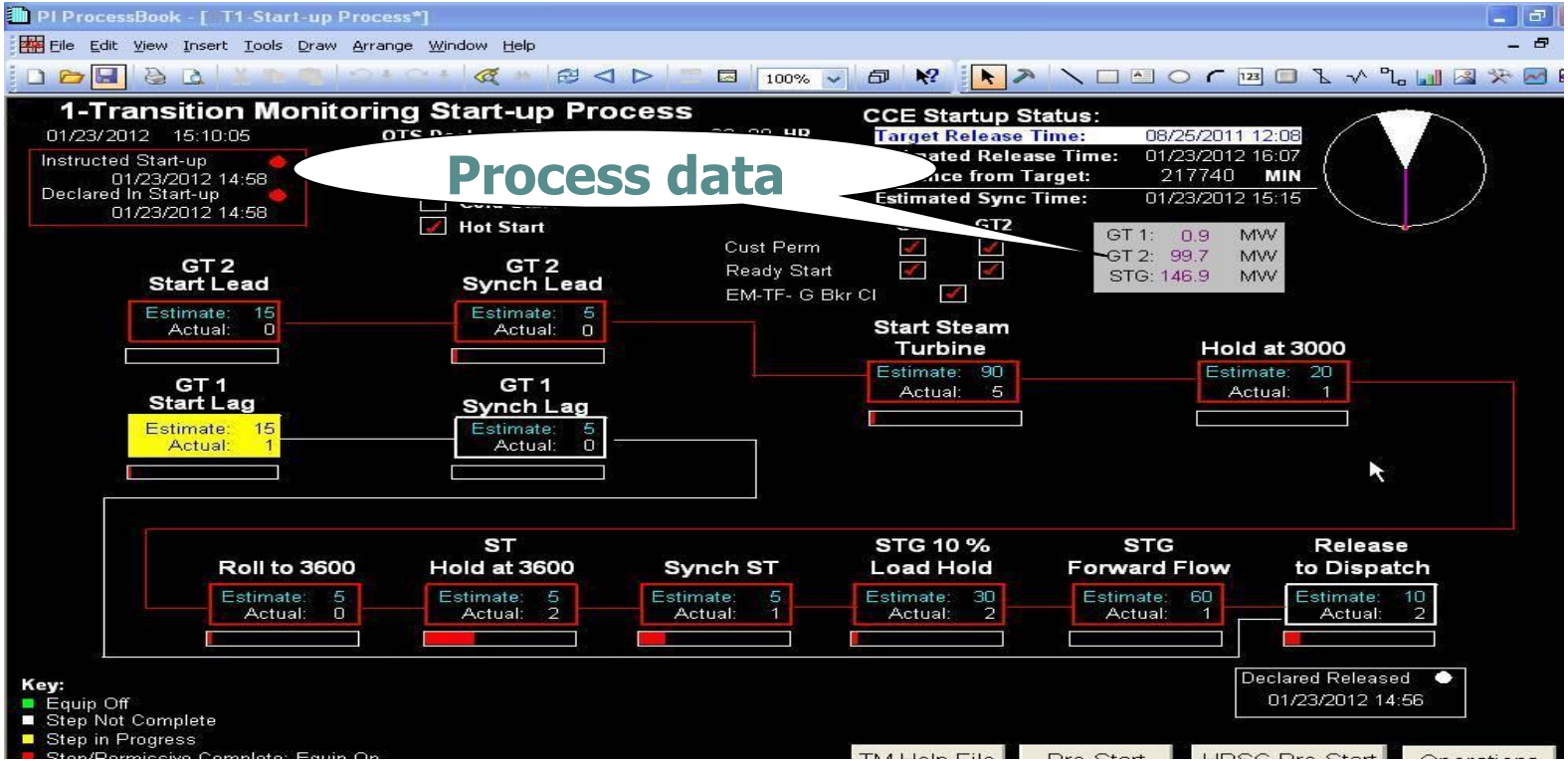

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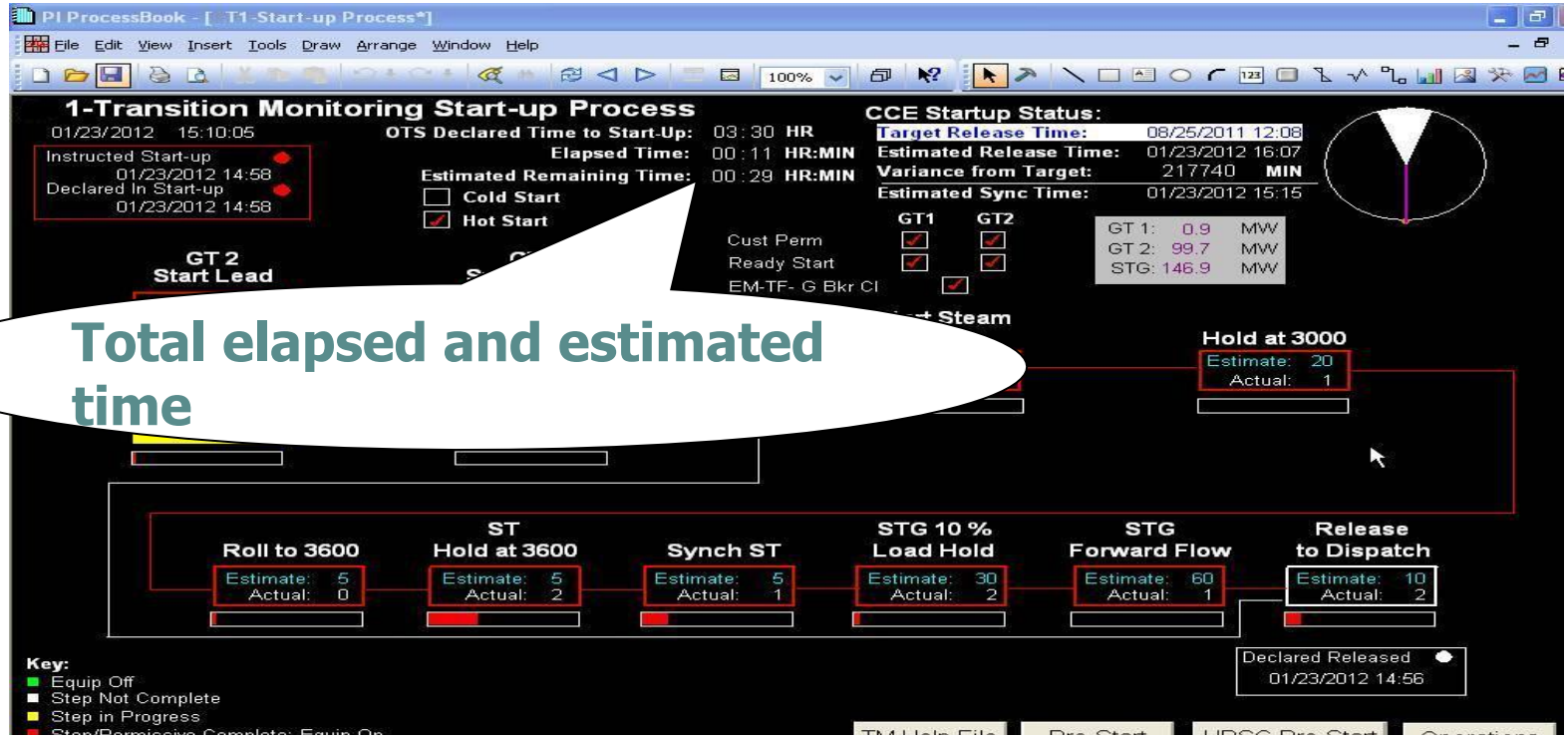
New PI Solution: Transition Monitor



Total elapsed and estimated time

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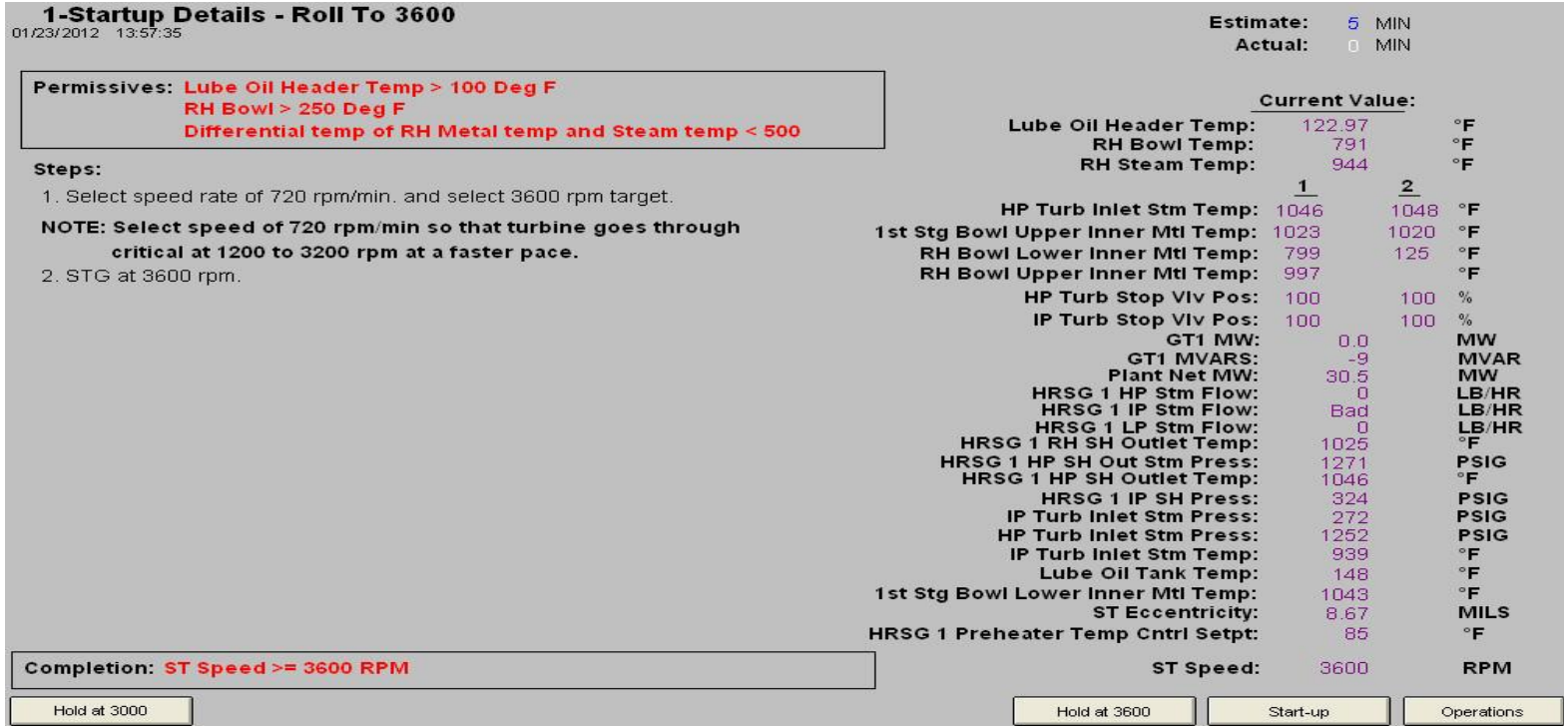
Startup Process Block Details



	Current Value:		
Lube Oil Header Temp:	122.97		°F
RH Bowl Temp:	791		°F
RH Steam Temp:	944		°F
	1	2	
HP Turb Inlet Stm Temp:	1046	1048	°F
1st Stg Bowl Upper Inner Mtl Temp:	1023	1020	°F
RH Bowl Lower Inner Mtl Temp:	799	125	°F
RH Bowl Upper Inner Mtl Temp:	997		°F
HP Turb Stop Vlv Pos:	100	100	%
IP Turb Stop Vlv Pos:	100	100	%
GT1 MW:	0.0		MW
GT1 MVARS:	-9		MVAR
Plant Net MW:	30.5		MW
HRSG 1 HP Stm Flow:	0		LB/HR
HRSG 1 IP Stm Flow:	Bad		LB/HR
HRSG 1 LP Stm Flow:	0		LB/HR
HRSG 1 RH SH Outlet Temp:	1025		°F
HRSG 1 HP SH Out Stm Press:	1271		PSIG
HRSG 1 HP SH Outlet Temp:	1046		°F
HRSG 1 IP SH Press:	324		PSIG
IP Turb Inlet Stm Press:	272		PSIG
HP Turb Inlet Stm Press:	1252		PSIG
IP Turb Inlet Stm Temp:	939		°F
Lube Oil Tank Temp:	148		°F
1st Stg Bowl Lower Inner Mtl Temp:	1043		°F
ST Eccentricity:	8.67		MILS
HRSG 1 Preheater Temp Cntrl Setpt:	85		°F
ST Speed:	3600		RPM

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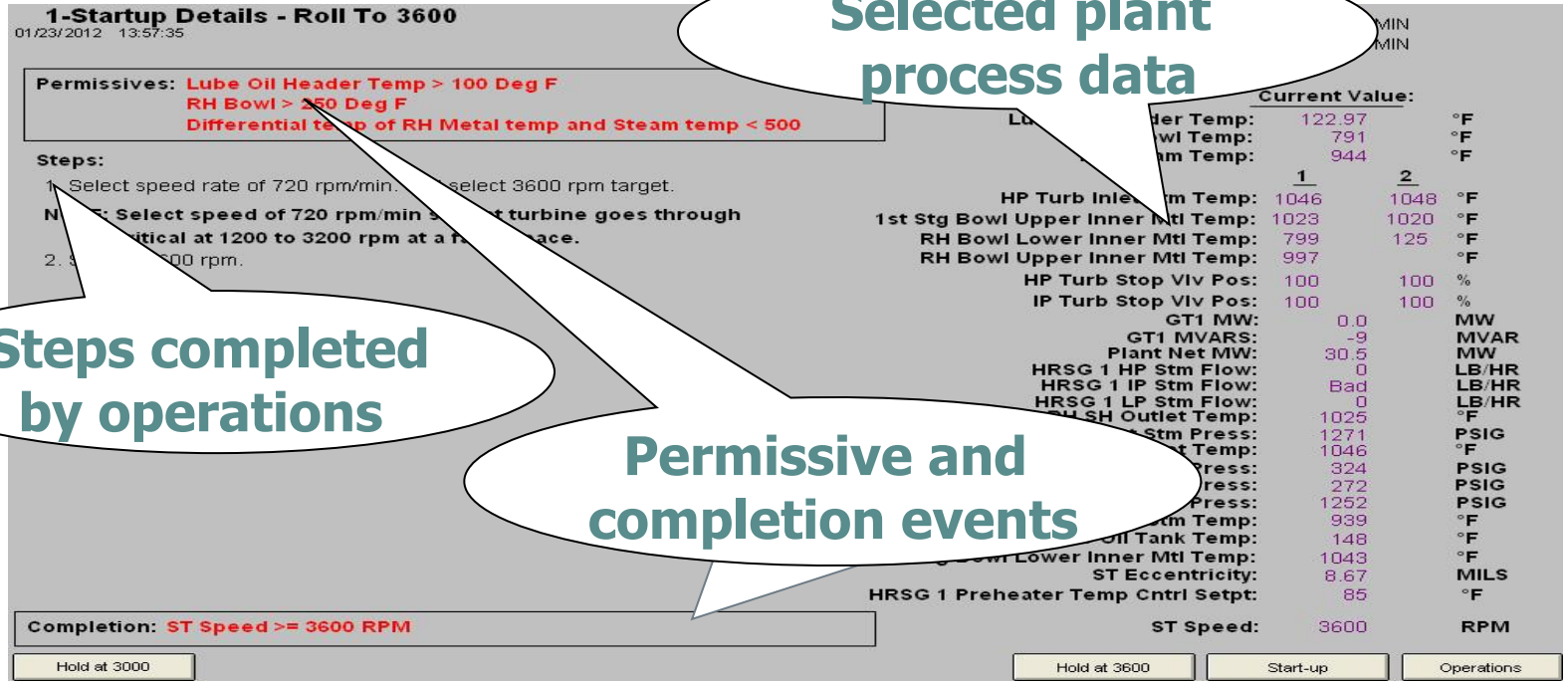
Startup Process Block Details



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Tracking Start-ups using PI Batch

Design Requirements:

- Well-defined start and end points
  - Valve open/closed
  - Flow > set limit
  - Pump on/off

- Consistently-followed procedures

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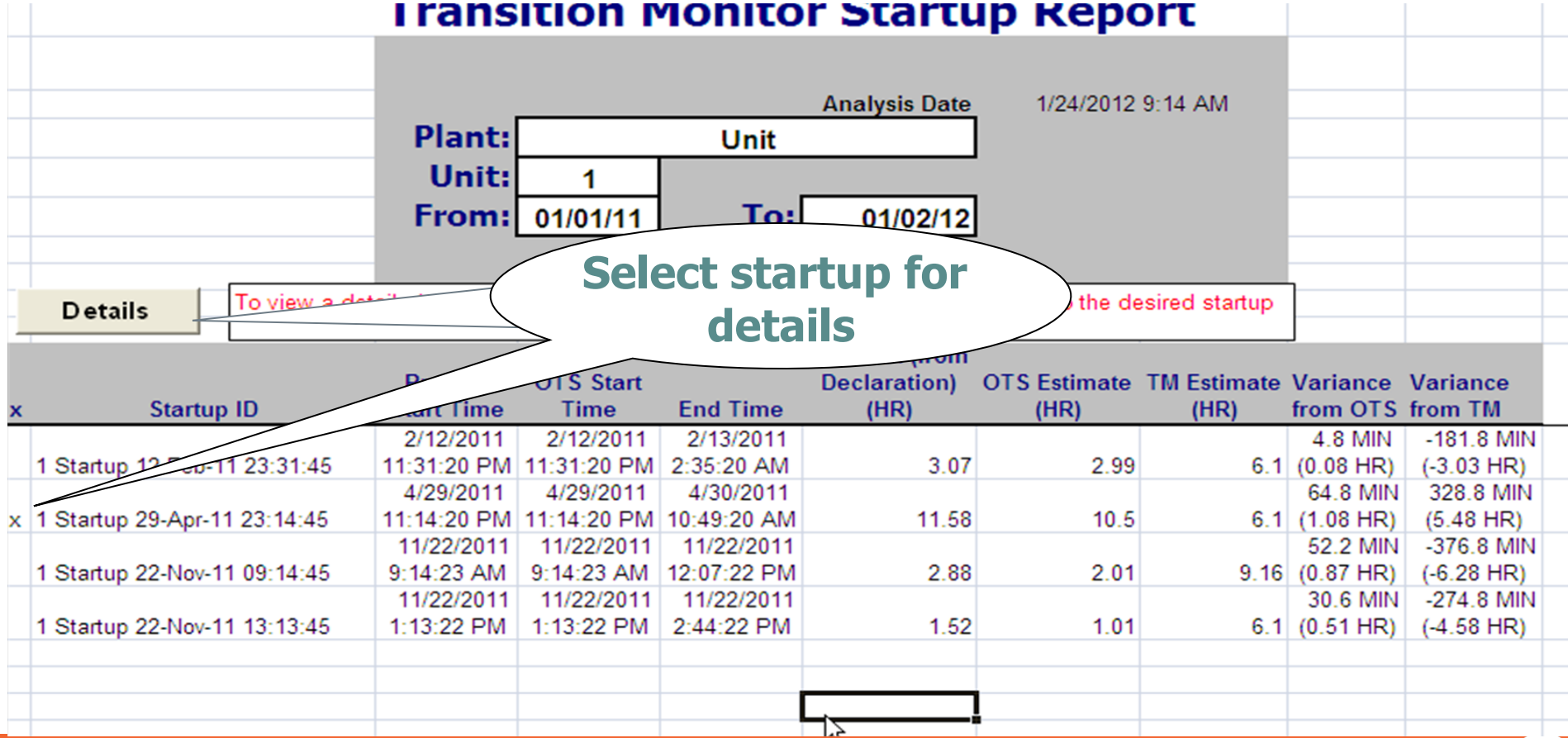
Improved Startup Reporting via Batch and the SDK



x	Startup ID	Start Time	OTS Start Time	End Time	Declaration) (HR)	OTS Estimate (HR)	TM Estimate (HR)	Variance from OTS	Variance from TM
	1 Startup 12-Dec-11 23:31:45	2/12/2011 11:31:20 PM	2/12/2011 11:31:20 PM	2/13/2011 2:35:20 AM	3.07	2.99	6.1	4.8 MIN (0.08 HR)	-181.8 MIN (-3.03 HR)
x	1 Startup 29-Apr-11 23:14:45	4/29/2011 11:14:20 PM	4/29/2011 11:14:20 PM	4/30/2011 10:49:20 AM	11.58	10.5	6.1	64.8 MIN (1.08 HR)	328.8 MIN (5.48 HR)
	1 Startup 22-Nov-11 09:14:45	11/22/2011 9:14:23 AM	11/22/2011 9:14:23 AM	11/22/2011 12:07:22 PM	2.88	2.01	9.16	52.2 MIN (0.87 HR)	-376.8 MIN (-6.28 HR)
	1 Startup 22-Nov-11 13:13:45	11/22/2011 1:13:22 PM	11/22/2011 1:13:22 PM	11/22/2011 2:44:22 PM	1.52	1.01	6.1	30.6 MIN (0.51 HR)	-274.8 MIN (-4.58 HR)

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Improved Startup Reporting via Batch and the SDK

				Analysis Date	1/24/2012 9:14 AM
Plant:	Unit				
Unit:	1				
		Duration (HR)	**OTS Estimate (HR)**	**Variance from OTS**	
Startup ID	1 Startup 29-Apr-11 23:14:45	11.58	10.5	64.8 MIN (1.08 HR)	
OTS Start Time	4/29/2011 11:14:20 PM				
End Time	4/30/2011 10:49:20 AM				
1st Stg Mtl Temp					

Phase	Start Time	End Time	Duration	TM Estimate	Variance from TM
CW Pmp	4/28/2011 12:06	----	----	----	----
FD Fan	4/29/2011 22:08	----	----	----	----
Startup	**4/29/2011 23:14**	**4/30/2011 10:49:20 AM**	**695 MIN (11.58 HR)**	**366 MIN (6.1 HR)**	**329 MIN (5.48 HR)**
Station Air Sys	4/30/2011 0:39	----	----	----	----
Condenser	4/30/2011 0:45	4/30/2011 2:05	80 MIN (1.33 HR)	0 MIN (0 HR)	80 MIN (1.33 HR)
Build Drum Pressure	4/30/2011 1:13	4/30/2011 1:14	0.08 MIN (0 HR)	180 MIN (3 HR)	-179.92 MIN (-3 HR)
Establish Vacuum	4/30/2011 1:14	4/30/2011 2:05	51 MIN (0.85 HR)	60 MIN (1 HR)	-9 MIN (-0.15 HR)
Satisfy Steam Conditions	4/30/2011 1:14	4/30/2011 2:02	48 MIN (0.8 HR)	30 MIN (0.5 HR)	18 MIN (0.3 HR)
Boiler	4/30/2011 2:01	4/30/2011 2:02	0.08 MIN (0 HR)	0 MIN (0 HR)	0.08 MIN (0 HR)
Turbine	4/30/2011 2:05	4/30/2011 2:28	23 MIN (0.38 HR)	0 MIN (0 HR)	23 MIN (0.38 HR)
Condenser	4/30/2011 2:28	4/30/2011 3:43	75 MIN (1.25 HR)	0 MIN (0 HR)	75 MIN (1.25 HR)
Establish Vacuum	4/30/2011 2:28	4/30/2011 3:43	75 MIN (1.25 HR)	60 MIN (1 HR)	15 MIN (0.25 HR)
Boiler	4/30/2011 3:25	4/30/2011 3:58	33 MIN (0.55 HR)	0 MIN (0 HR)	33 MIN (0.55 HR)
Satisfy Steam Conditions	4/30/2011 3:25	4/30/2011 3:58	33 MIN (0.55 HR)	30 MIN (0.5 HR)	3 MIN (0.05 HR)
Turbine	4/30/2011 3:58	4/30/2011 7:12	193.25 MIN (3.22 HR)	0 MIN (0 HR)	193.25 MIN (3.22 HR)
Roll to 2400	4/30/2011 4:10	4/30/2011 4:18	7.75 MIN (0.13 HR)	10 MIN (0.17 HR)	-2.25 MIN (-0.04 HR)
Achieve Stm Conditions for Hold	4/30/2011 4:18	4/30/2011 10:49	391.08 MIN (6.52 HR)	10 MIN (0.17 HR)	381.08 MIN (6.35 HR)
Condenser	4/30/2011 7:12	4/30/2011 7:23	11 MIN (0.18 HR)	0 MIN (0 HR)	11 MIN (0.18 HR)
Establish Vacuum	4/30/2011 7:12	4/30/2011 7:23	11 MIN (0.18 HR)	60 MIN (1 HR)	-49 MIN (-0.82 HR)

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Future Enhancements/Path?

- PI 2012 – Recalculating without reprocessing!
- PI Manual Logger and other manual data entry
- Shutdown monitors
- PI Asset Framework
- Water chemistry reporting for startups

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Questions?

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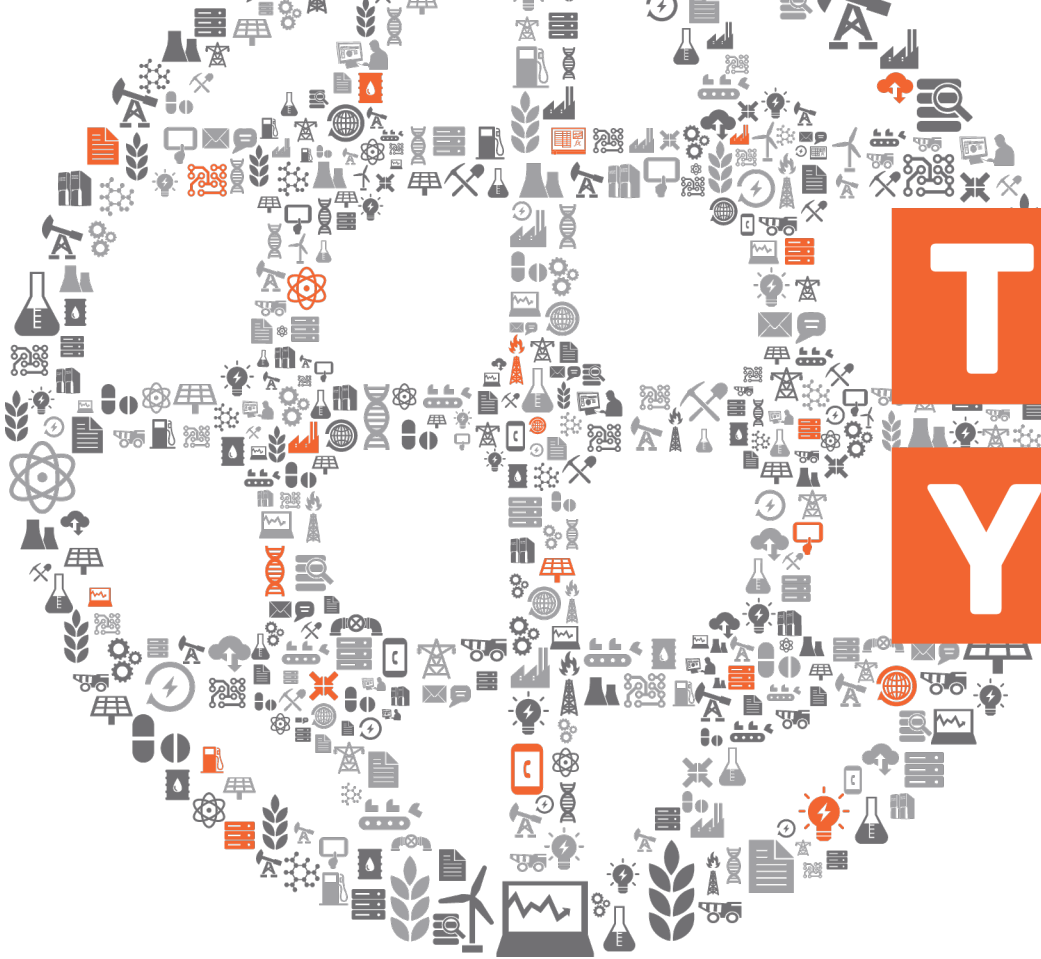

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