Monticello Nuclear Generating Plant

Plant Process Computer System Replacement
Russ Van Dell, True North Consulting
Curtiss-Wright Symposium, August, 2018

Minnesota

❑ Last Year, the New York Times stated that "After having dug to a depth of 10 feet, a team of New York scientists found traces of copper wire dating back 100 years. They came to the conclusion that their ancestors already had a telephone network more than 100 years ago."

❑ Not to be outdone by the New Yorkers, in the weeks that followed, California archeologists dug to a depth of 20 feet and the Los Angeles Times wrote "California Archeologists report finding of 200 year old Copper wire, have concluded that their ancestors had an advanced communications network more than 200 years ago"

❑ One week later, a local Minnesota newspaper reported that "After digging to a depth of more than 30 feet in his pasture near Twig, Minnesota, Ole Svenson, a self taught Archeologist, reported that he found absolutely nothing. This led Ole to conclude that more than 300 years ago"
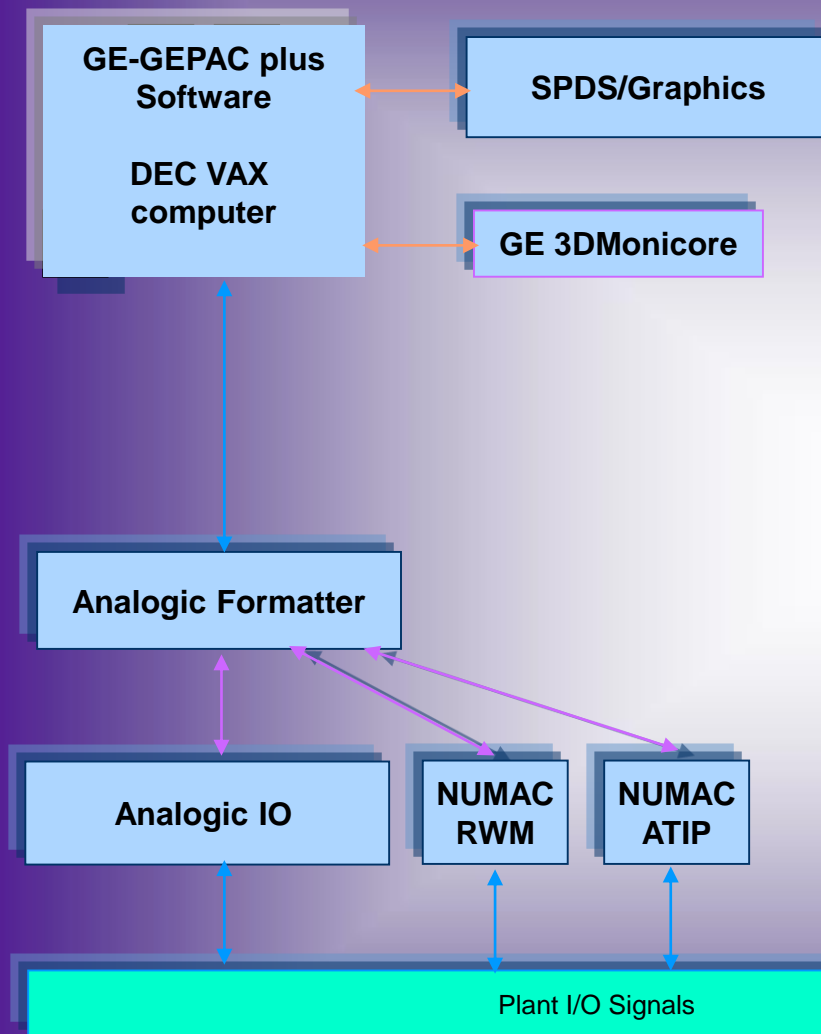
Minnesota had already gone "Wireless".

Minnesota Proud!

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Monticello Nuclear Generating Plant
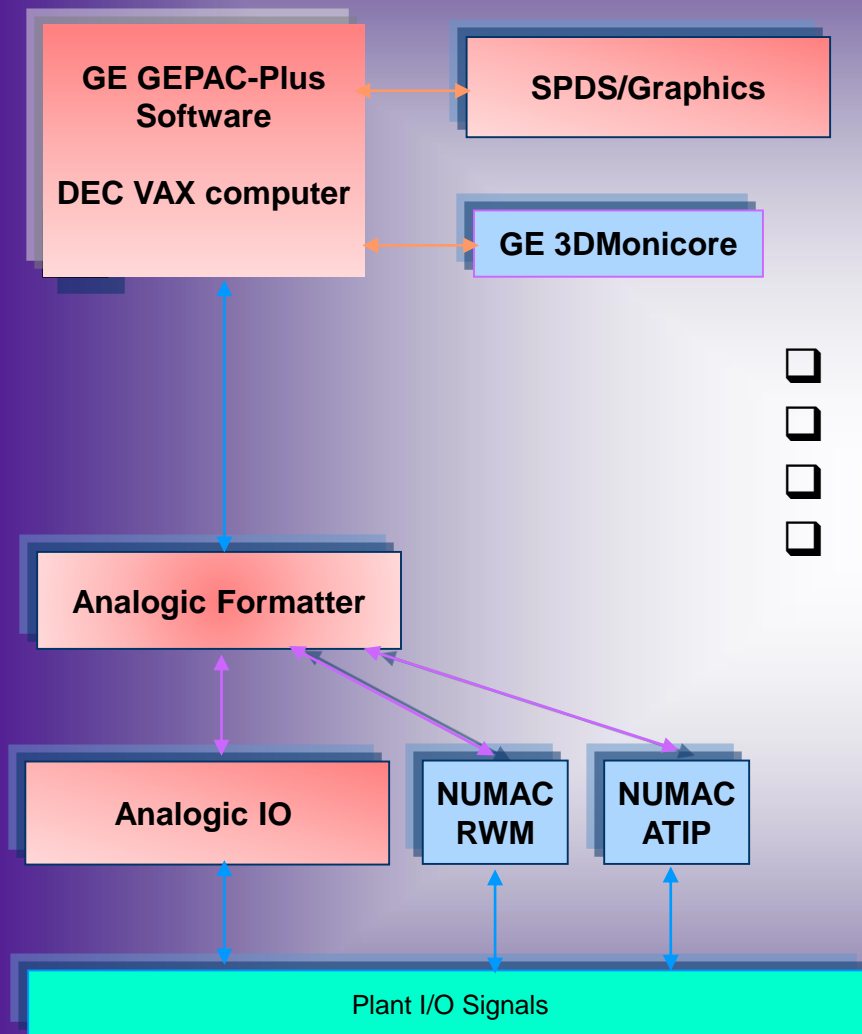
- **Xcel Energy (Minnesota, N & S Dakota, Wisconsin, Michigan, Colorado, New Mexico, Texas)**
    - **Largest Wind Producer**
    - **80% Carbon Free by 2030 (with Nuclear Plants)**

- **Monticello, Minnesota**

- **GE BWR3**

- **First On-Line 1971**

- **691 Mega-Watts**

- **Plant Life Extension to 2031**

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MNGP PPCS Migration – Original GEPAC+

GE-GEPAC plus Software

DEC VAX computer

SPDS/Graphics

GE 3DMonicore

Analogic Formatter

Analogic IO

NUMAC RWM

NUMAC ATIP

Plant I/O Signals

- ❑ **GE GEPAC-Plus System**
- ❑ **DEC VAX computers**
- ❑ **ANALOGICS DAS**
- ❑ **GE NUMAC RWM & ATIP**
- ❑ **GE 3D Monicore**
- ❑ **Toshiba Color Graphics**
- ❑ **Installed 1985-1987**

MNGP PPCS Migration – 2002 Decision

GE GEPAC-Plus Software

DEC VAX computer

SPDS/Graphics

GE 3DMonicore

Analogic Formatter

Analogic IO

NUMAC RWM

NUMAC ATIP

Plant I/O Signals

- ❑ **Graphics failing, not fixable (2002)**
- ❑ **PLEX not approved**
- ❑ **Plant Licensed only to 2011**
- ❑ **Not prudent to do full replace @ $$mil**

MNGP PPCS Migration – 2002
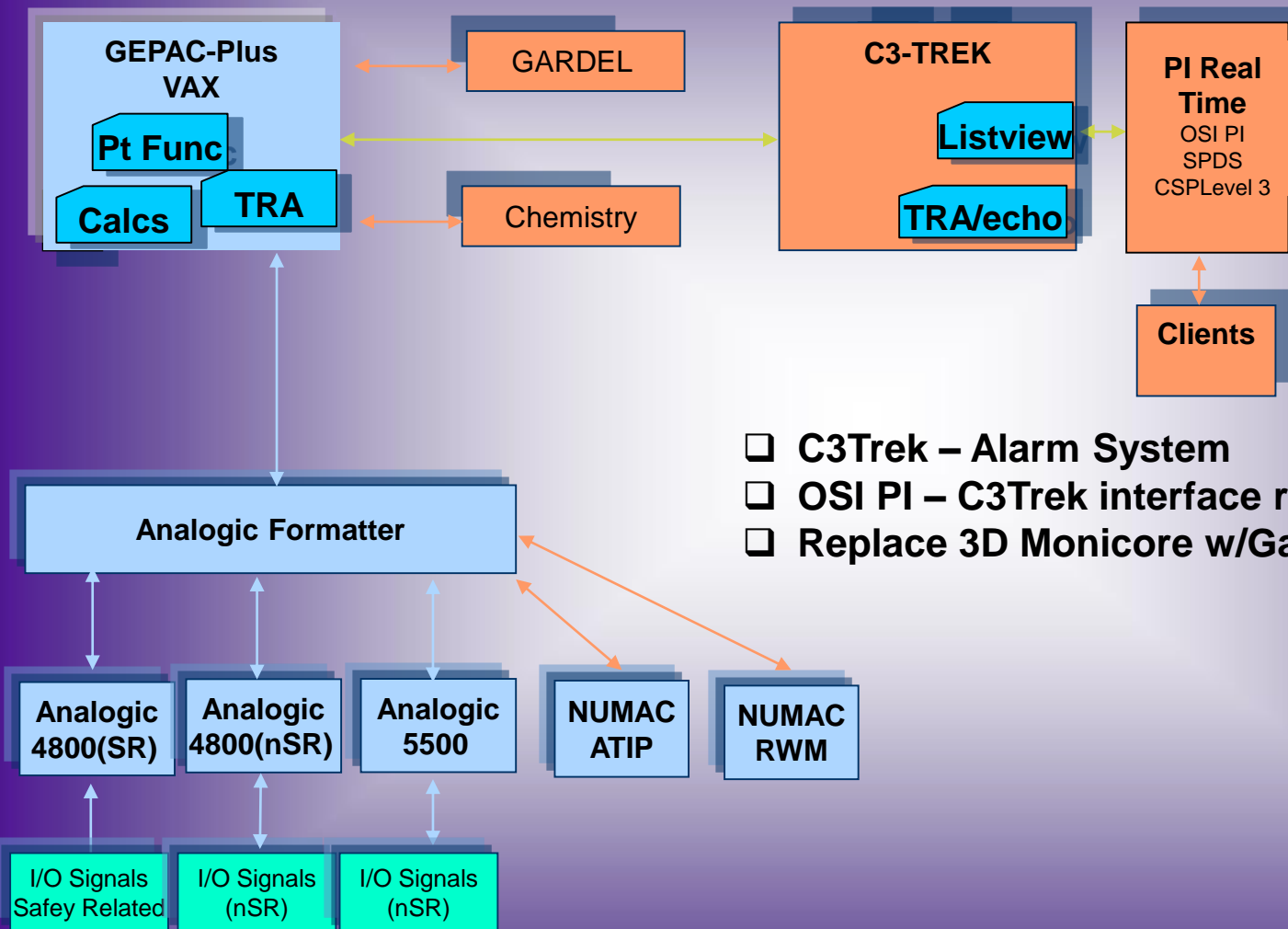
- ❑ **C3Trek – Alarm System**
- ❑ **OSI PI – C3Trek interface replace graphics**
- ❑ **Replace 3D Monicore w/Gardel**

PPCS Migration 2007-2013– Expand C3TREK

- ❑ **Plant projects priority over PPCS replacement**
- ❑ **Old DAS system not expandable – obsolete**
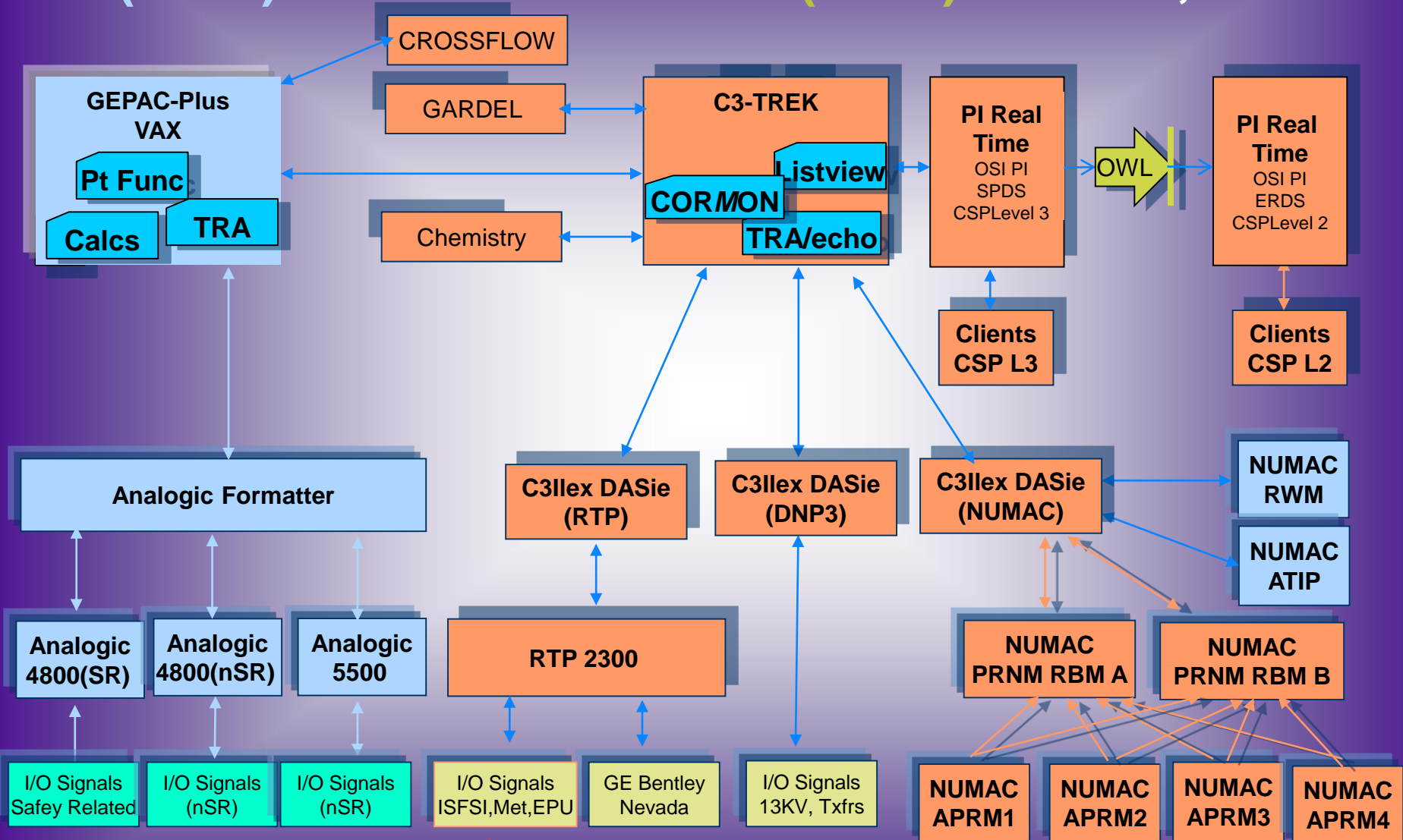- ❑ **Support projects using C3Trek system as base system**

High Priority Multiple Plant upgrades
- ❑ **ISFSI**
- ❑ **Crossflow Project (MUR/FW loss recovery)**
- ❑ **Cyber Security – Data Diodes**

Extended Power Uprate
- ❑ **Power Range Neutron Monitors (PRNM)**
- ❑ **Bentley Nevada Vibration Monitoring**
- ❑ **Met Tower/RASCAL/Chemistry**
- ❑ **13KV, Transformers, RFP/CDP, Recirc MG Sets, Turbine**
- ❑ **MELLA+**

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Current Configuration Hybrid - GE GEPAC+ (1984) & C3-Ilex C3TREK (2006)– March, 2016

MNGP PPCS Replacment –C3ilex CTREK Option

- ❑ **MNGP had implemented C3-ilex's C3-TREK system**
- ❑ **Graphics System based on OSI-PI**
- ❑ **DASie – Alternate to GE MVD, NIC (later)**
- ❑ **ATIP, RWM, PRNM implementation based on DASie design**
- ❑ **OD1 – TIP processing C3-ilex – Gardel no TIP processing**
- ❑ **RTP 2000 Interface based on DASie design**
- ❑ **Analogics support part of DASie design**
- ❑ **C3TREK calculations, interfaces**
- ❑ **Low cost, off-the-shelf technologies**

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MNGP PPCS Replacement Timeline

❑ **June, 2015 – C3-ilex decided to shutdown business**

❑ **August 2015 – RFP Proposal issued to vendors for alternate approach**

❑ **December 2015 – Contract awarded to Curtiss Wright to replace GE GEPAC+ and C3-ilex C3-TREK systems**

❑ **November, 2016 – Contract awarded to GE – GE LINK**

❑ **2017-2018 – DAS Implementation & R*Time Design**

❑ **April, 2019 – FAT**

❑ **September, 2019 - Completion**

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MNGP Project Approach - DAS

- ❑ **Project split to 2 parts – Hybrid Architecture**
    - ❑ **DAS- Convert from Analogic to RTP 3000 (Xcel Energy)**
    - ❑ **PPCS – Replace GEPAC and C3TREK (Curtiss-Wright,GE)**

- ❑ **DAS Implementation -off-line (RFO) – Critical Control Panels**
    - ❑ **Critical Control Panels (HWC, Off-Gas, Safety Instruments**
    - ❑ **PPCS Digitals – 450 pts – Used CW plug in adapter – Analogic to RTP**

- ❑ **DAS on line in plant – Rx Bldg Chemistry**
- ❑ **DAS on line – Computer Room - Challenging**
    - ❑ **Control system interfaces (some high risk) – Plant knowledge**
    - ❑ **Critical Points – special handling**
    - ❑ **Calculations**
    - ❑ **Interfaces (Maintain 100% Power)**

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DAS Replacement – EC-14189 DAS to new hardware
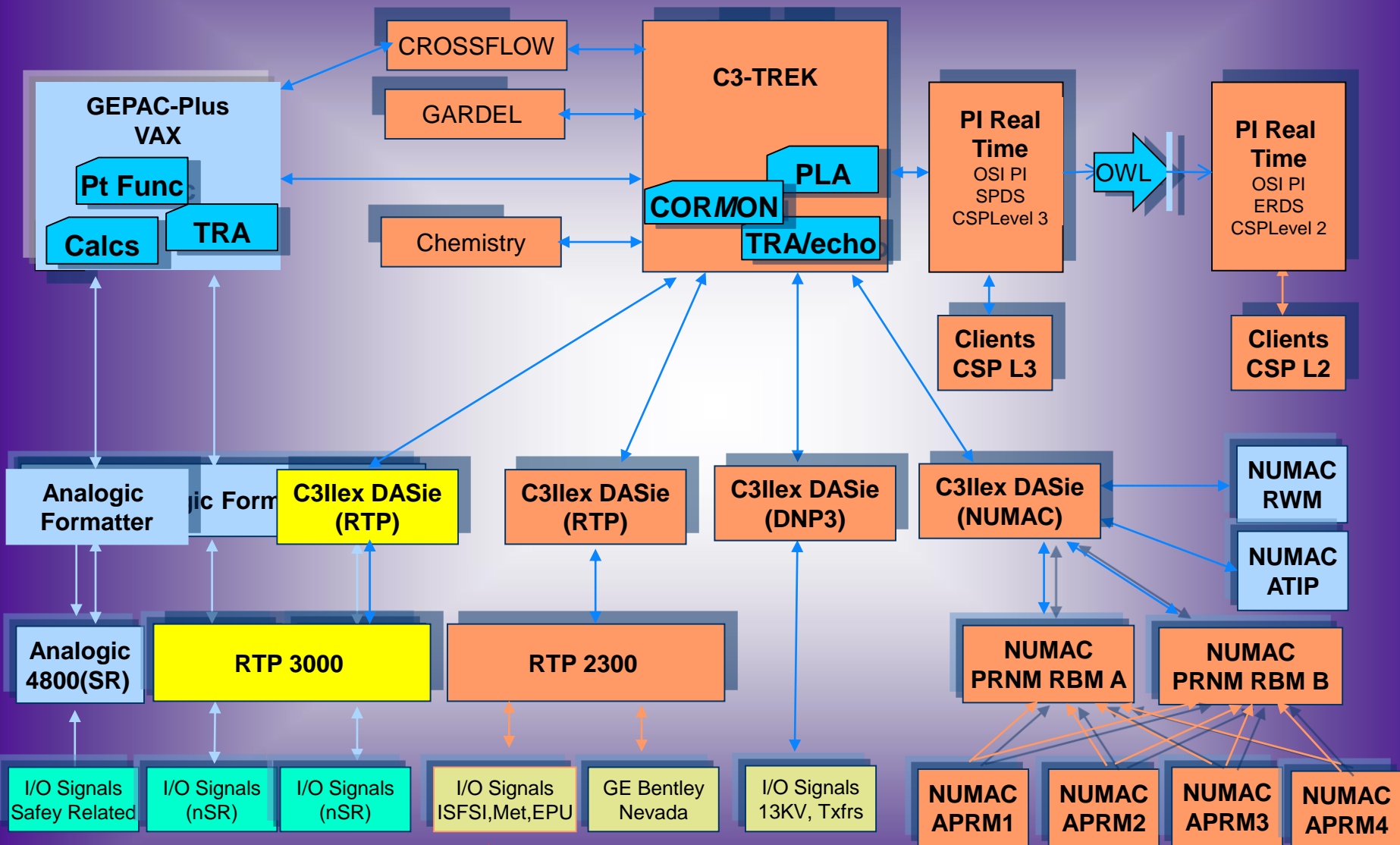
MNGP Project Approach – PPCS Challenges

- ❑ **PPCS – Replace GEPAC and C3TREK**
- ❑ **Replacement done with unit on-line – no capacity losses**
- ❑ **Knowledge, Documentation, Complexity, Size**
- ❑ **OD-1 TIP Processing – new to R*Time, part of 3DMonicore**
- ❑ **NUMAC & Analogic Interface C3-ilex DASie**
- ❑ **Calculations - GEPAC Scheduler versus R*TIME**
- ❑ **TRA speed – Analogics (4msec – Analog)**
- ❑ **10ohm RTDs Noise – RTP**
- ❑ **Interfaces – Complex, Different technologies**
- ❑ **Funding – EPU consumed all Capital investment**

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PPCS Replacement – EC-19932
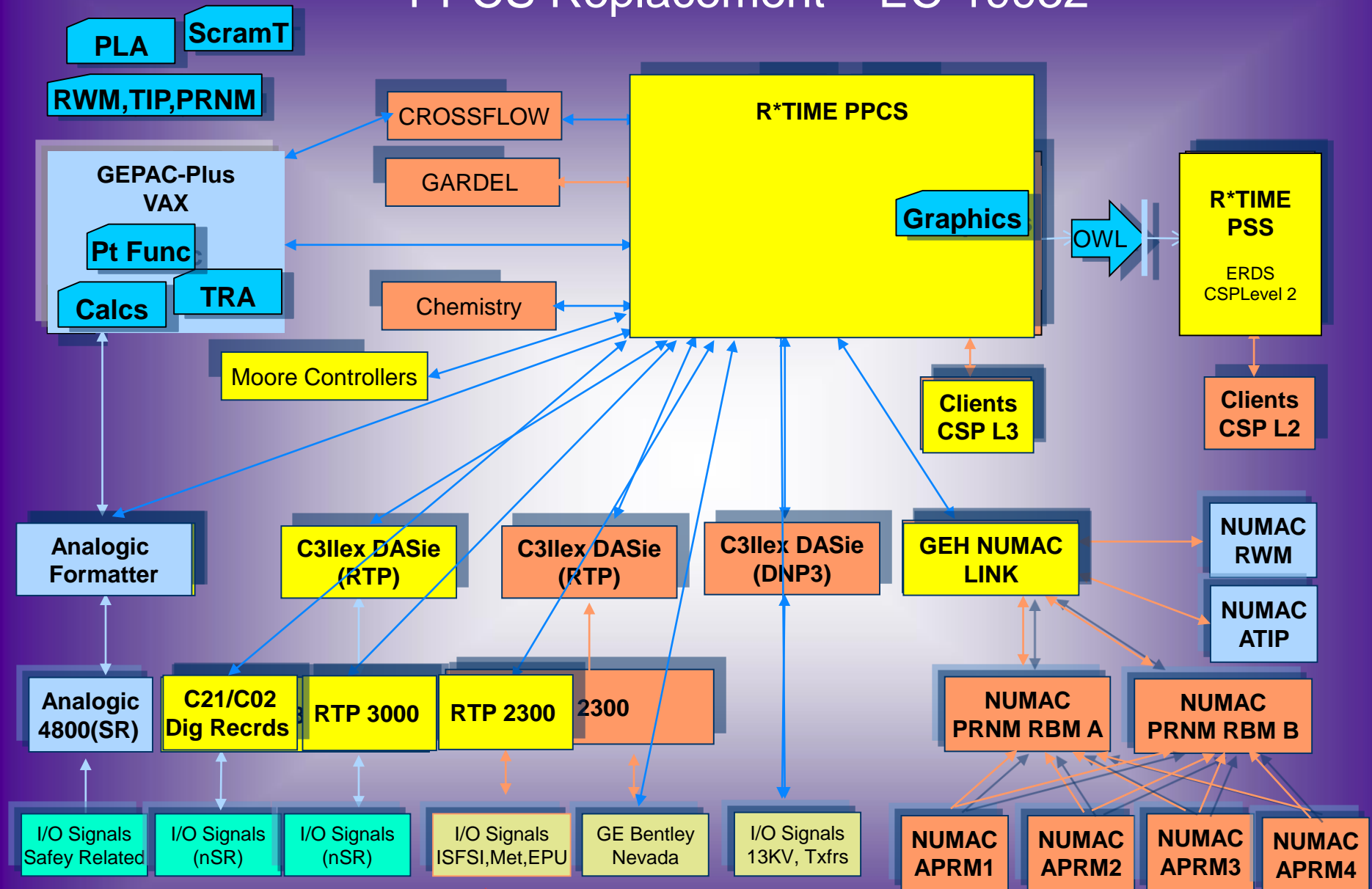
MNGP Project Approach – PPCS Enhancements

- ❑ **PVQ – Point Manual Insert both Value & Quality**
- ❑ **Instrument Calibration**
  - ❑ **Remove Instrument from Processing (Manual Entry or not)**
  - ❑ **I&CS views live instrument input for cal purposes**
- ❑ **R*TIME version 15**
  - ❑ **Change Track Archive – GEPAC Delta Processing**
  - ❑ **Enhancements**
- ❑ **Scram Time Application**
  - ❑ **Scram Time data obtained from RWM**
  - ❑ **Calculations performed**
  - ❑ **Results on Graphic Display**
    - ❑ **Track Progress of Single Rod Scrams**
    - ❑ **Current Status of Control Rod Operability**
- ❑ **Digital Recorders – expand points, EOP abilities**
- ❑ **Gardel – Fuel Limit Calc Results – R*TIME**

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MNGP PPCS Enhancements - GELINK

- GE NUMAC LINK- GE's Replacement for MVD, NIC
- Input - Communicates with GE's Proprietary Products – Analogic, NUMAC (RWM, ATIP, PRNM)
- Output – PPCS Vendor Interface
  - UDP – Broadcast Mode
  - TCP – Interactive communication between NUMAC & PPCS
  - Keyswitch – Controls Mode (for Cyber Security)
- GE
  - Solid Engineering Support & Knowledge
  - GE NUMAC LINK - Delivered to two other non-RTIME plants
  - GE NUMAC LINK Ethernet Communication Protocol Specification
    - Provides exact details of all communication to/from GELINK
    - Available to PPCS Vendors for use in creating interface applications
- Integration/FAT Test at GE Lab, Wilmington
- Hardware Based on existing NUMAC components

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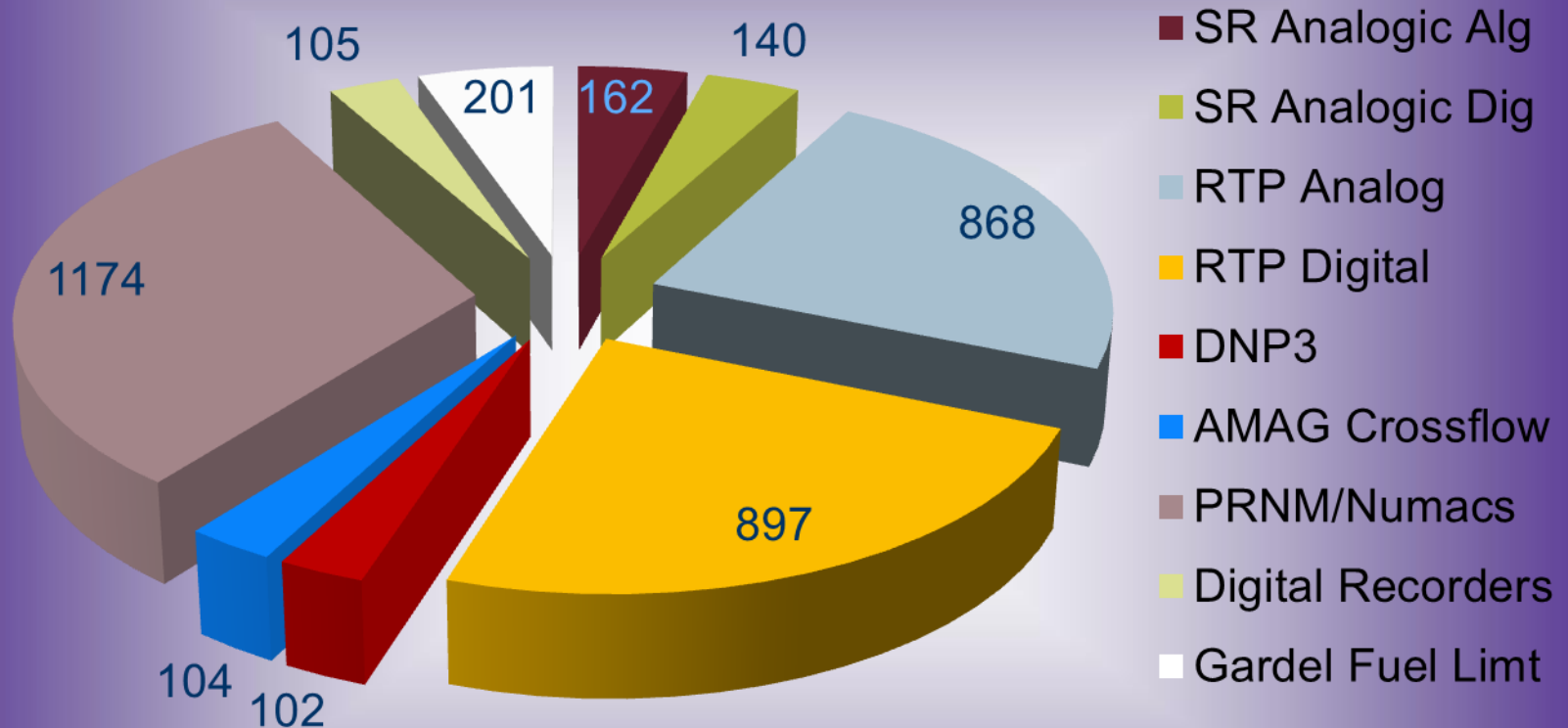
GE NUMAC LINK

GE NUMAC LINK Configuration
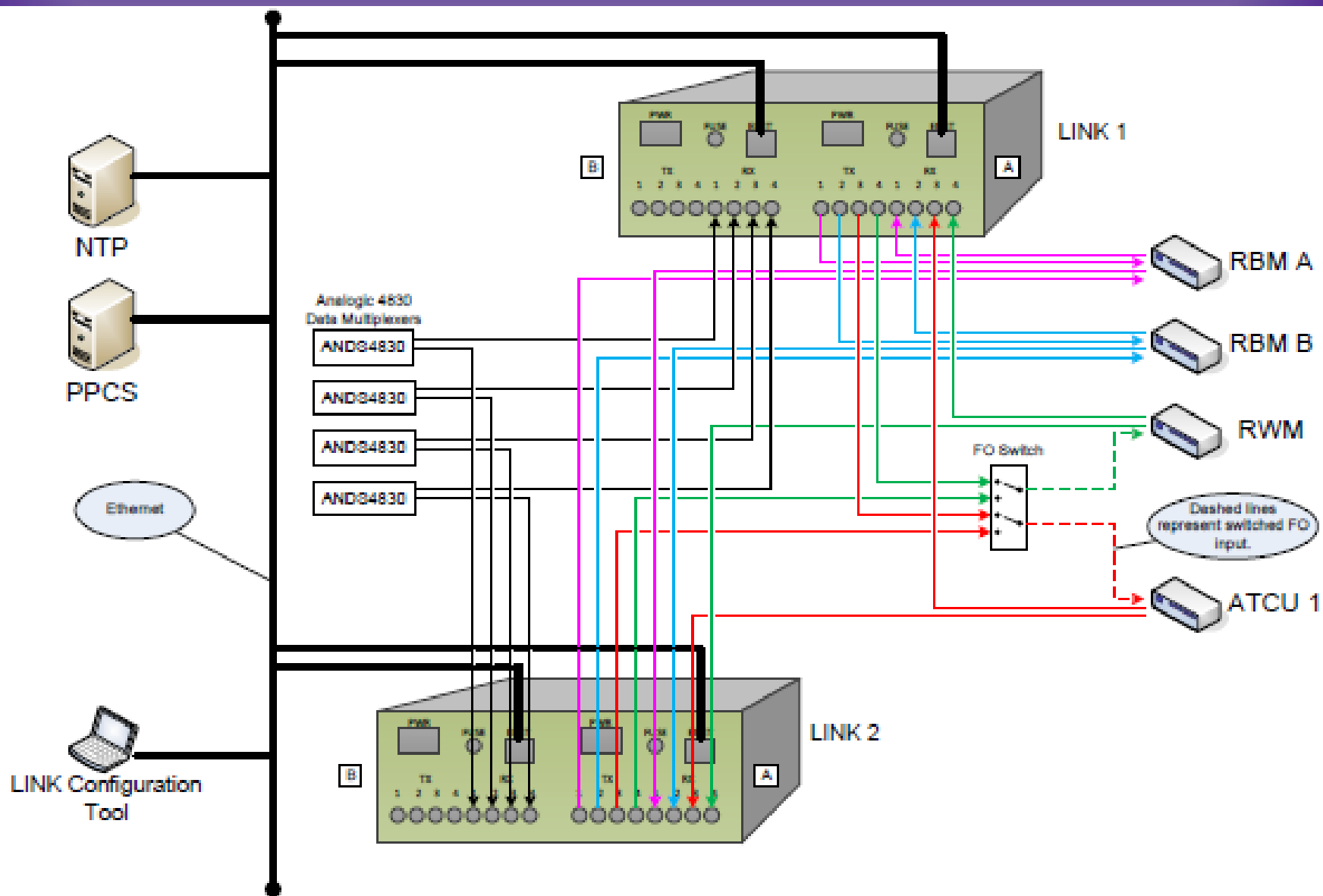
MNGP Project Resources

- Most of Project is Technical/Details/DAS Wiring
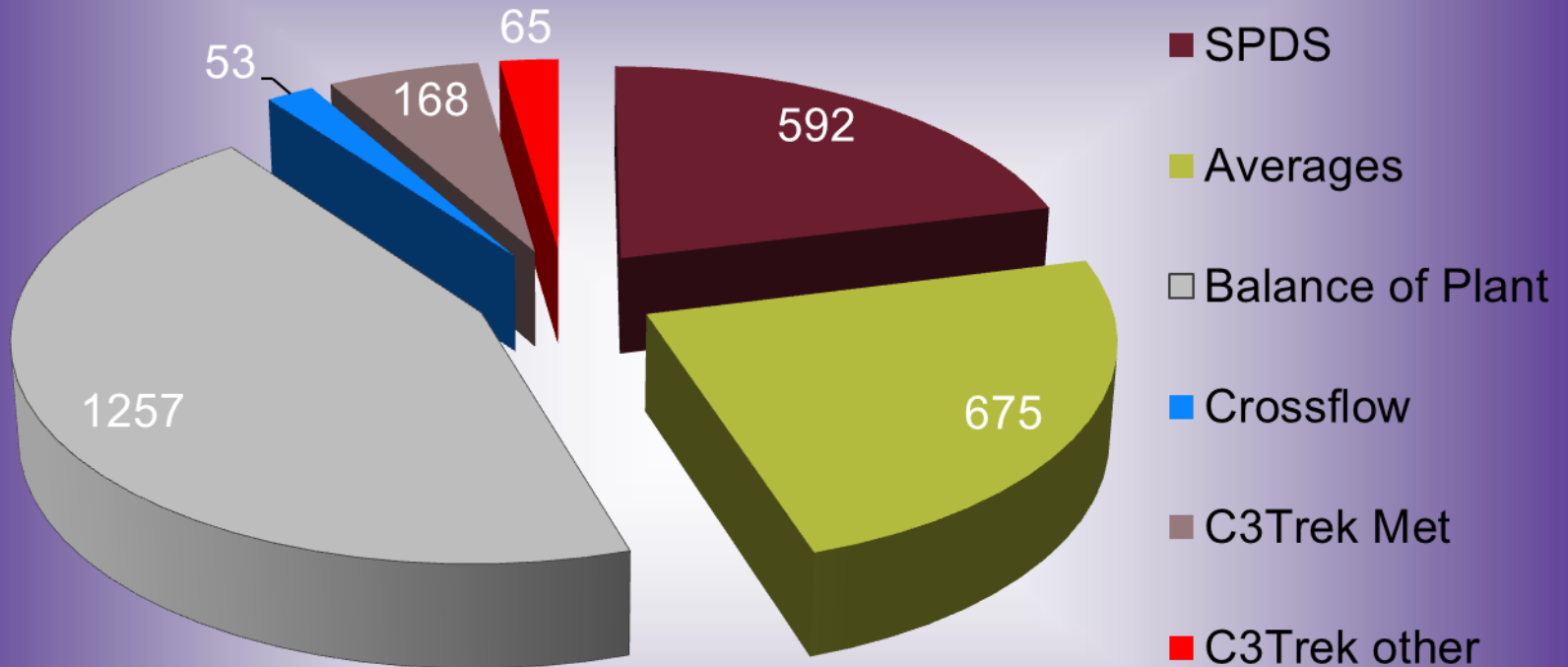- Minimal traditional engineering

- Project Management/Engineering
- Architect Engineering *not* used
- Project Manager (Projects Department)
- Engineering per Internal resources (IT & Design Engineering)
  - Computer Engineers
  - Retired Computer Engineer (Project Lead, True North Consulting)
  - Retired Master Instrument & Control Specialist (field engineering)
  - Retired Shift Manager (procedures, work plans)
  - Engineering Associate (procedures, test cases)
  - Nuclear Engineers (ATIP, Gardel, Scram Timing)
  - Design Engineering – w/Design Change Qualifications/Calcs
  - Work Planner
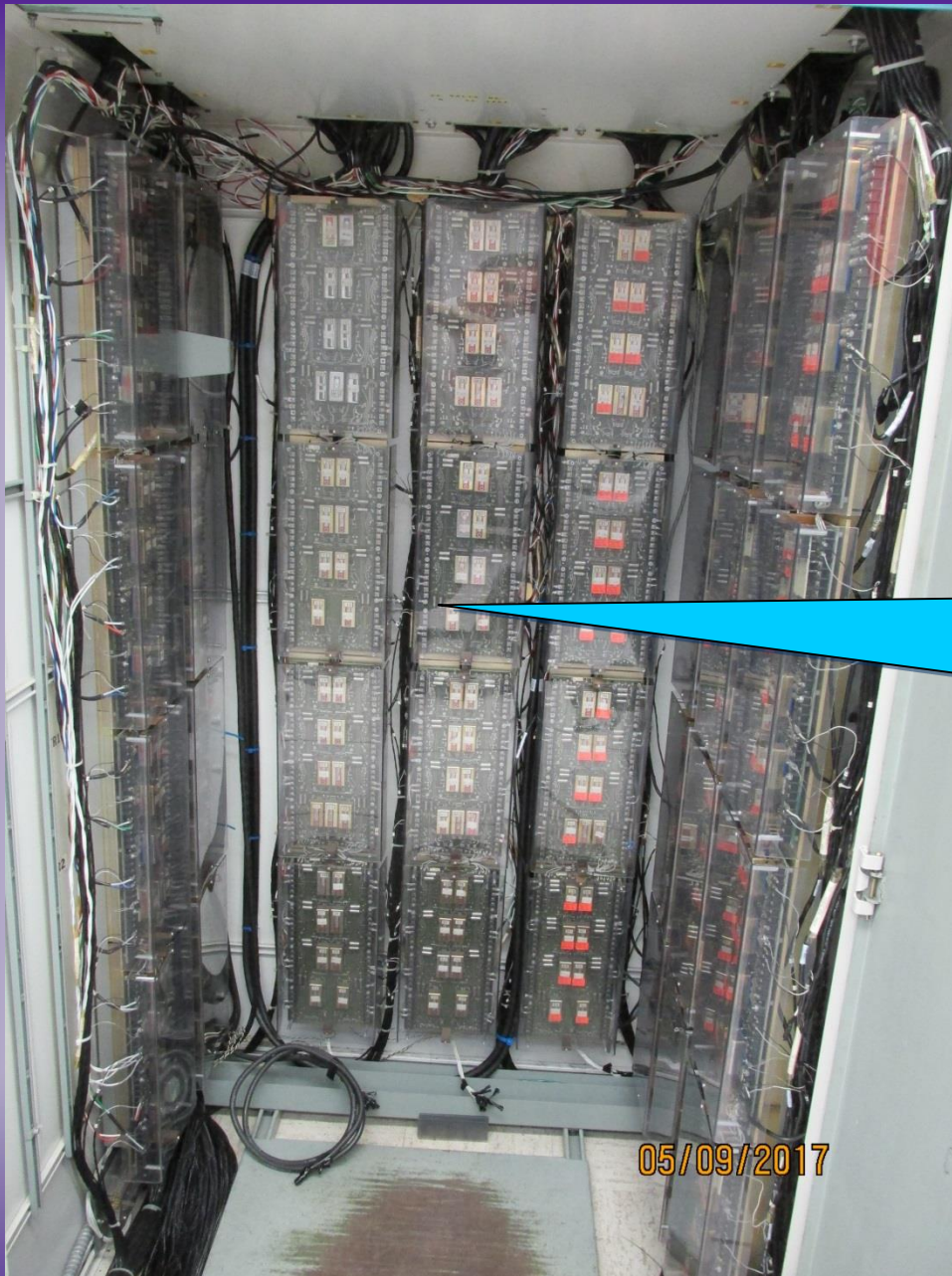- Challenge - Balance between DAS & PPCS work tasks

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PPCS Input Composition (3753)

Legend:
- SR Analogic Alg
- SR Analogic Dig
- RTP Analog
- RTP Digital
- DNP3
- AMAG Crossflow
- PRNM/Numacs
- Digital Recorders
- Gardel Fuel Limt

Values shown: 105, 140, 201, 162, 868, 1174, 897, 104, 102

DAS EC moves about 50% (1015pts) of hardwired Analog/Digital pts from Analogics (old) to RTP3000 (new).

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PPCS Calculated Point Composition (2810)

65
53
168
592
1257
675

SPDS
Averages
Balance of Plant
Crossflow
C3Trek Met
C3Trek other

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Original Honeywell IO Cab w/ Analogic

05/09/2017

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RTP Termination Modules

08/03/2018

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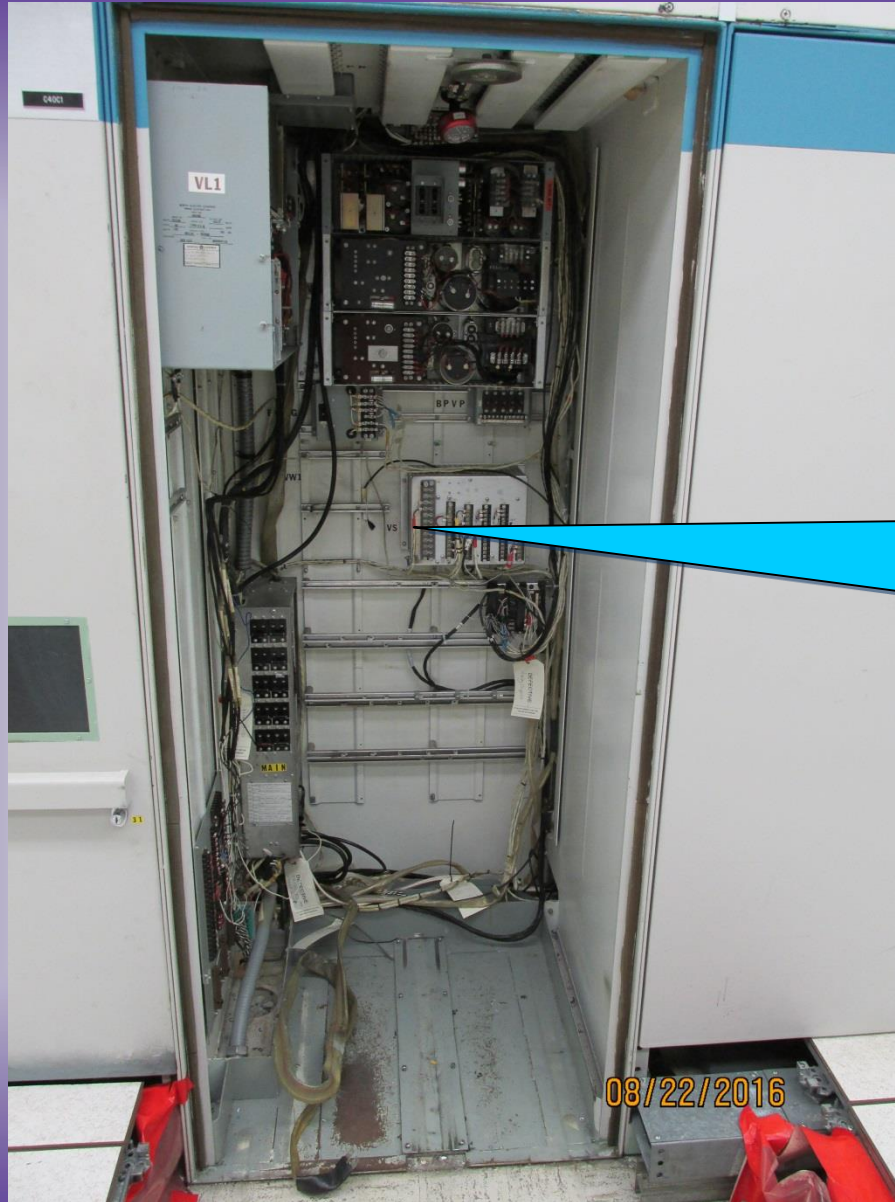
Original Honeywell Drum Cabinet

08/22/2016

RTP 3000s

05/09/2017

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Analogic 5500

RTP 3000

05/09/2017

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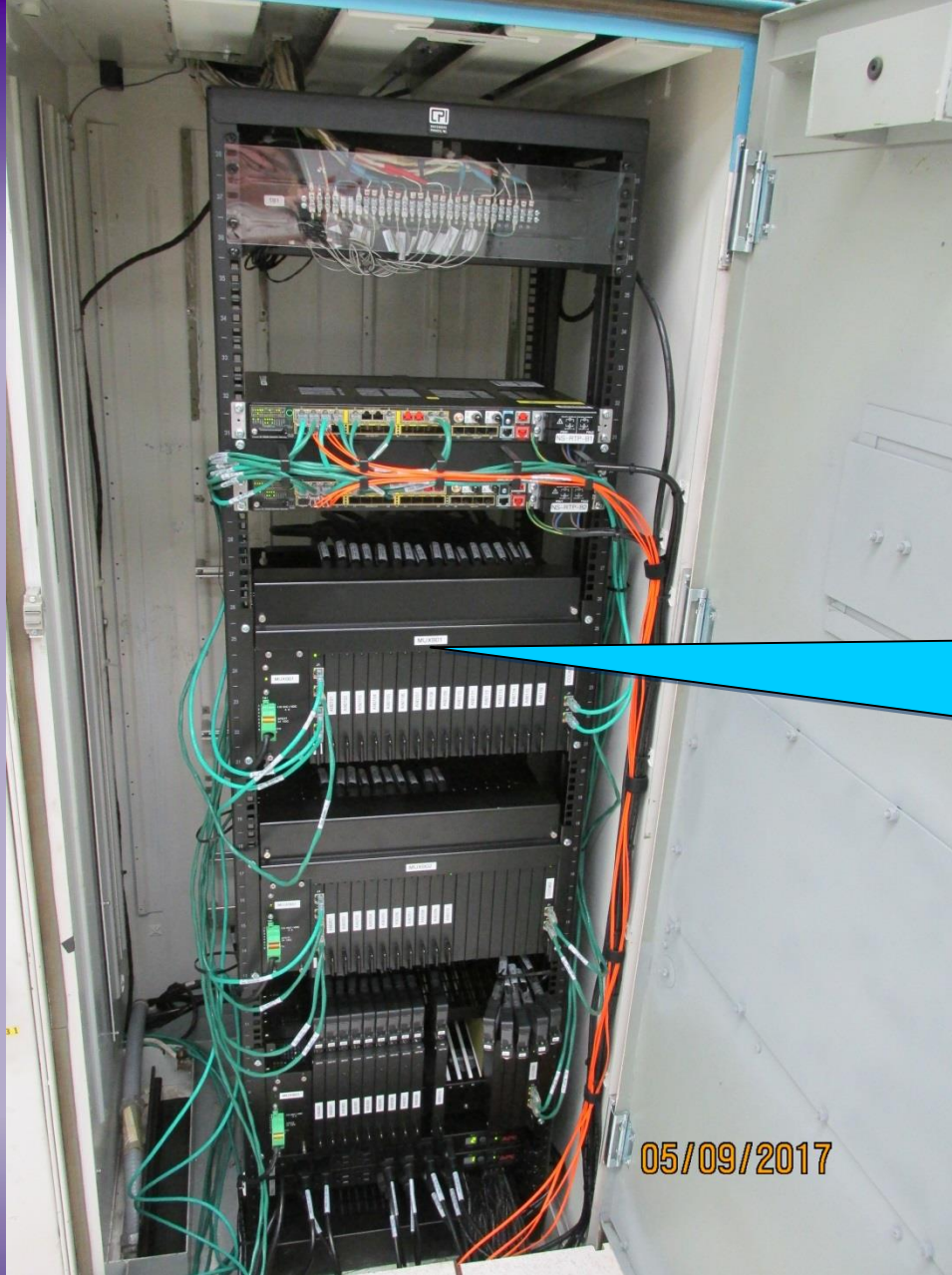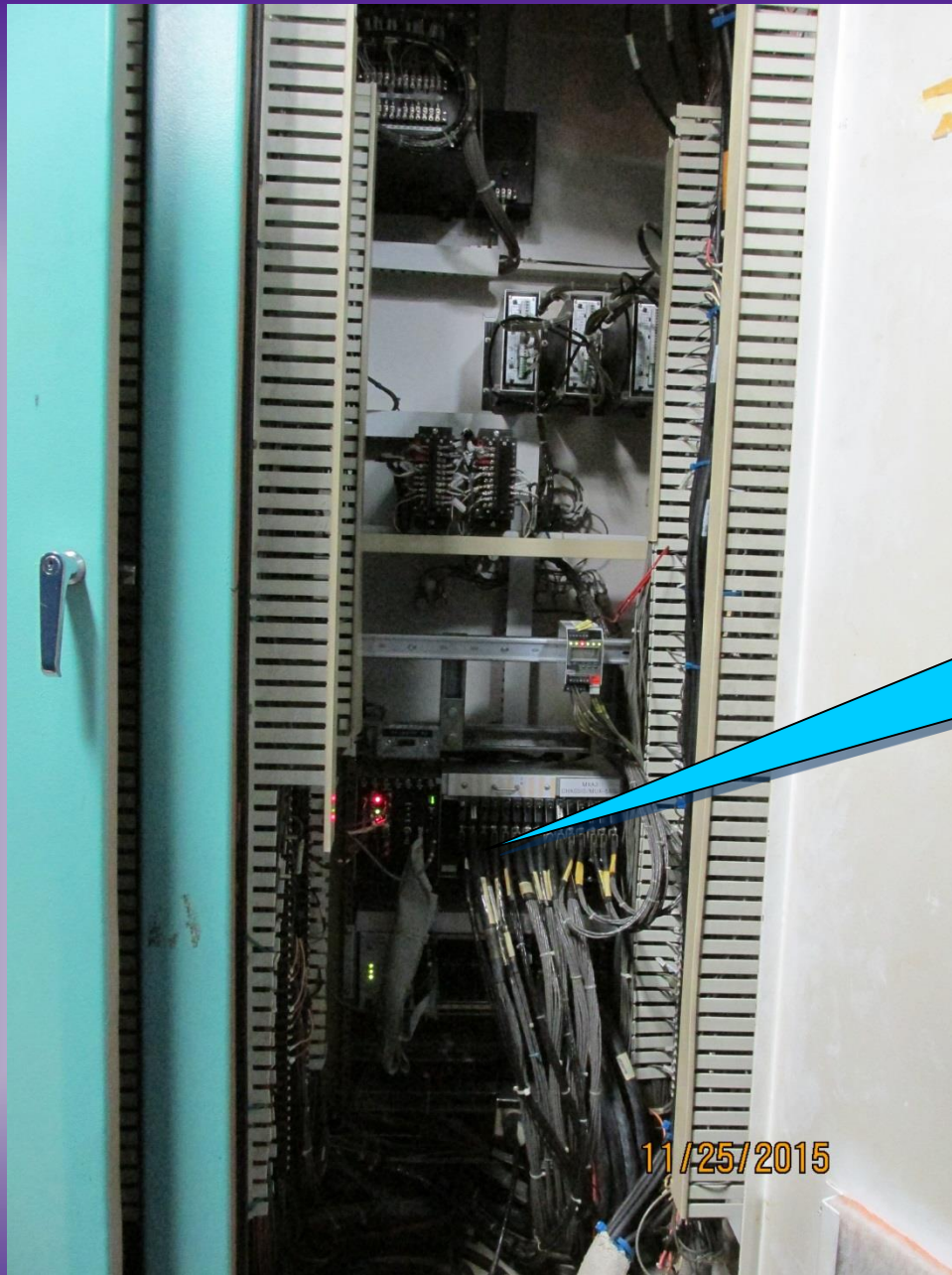
Your task as our selected Vendor

Some days we just get stuck, and bogged down.
Some days all you can do is smile and wait for someone to kindly
remove your butt from the hole you find it wedged into.

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