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# Lessons learned from a multi-million dollar, state-of-the-art distribution automation system upgrade project at California State University Fresno (OP038)

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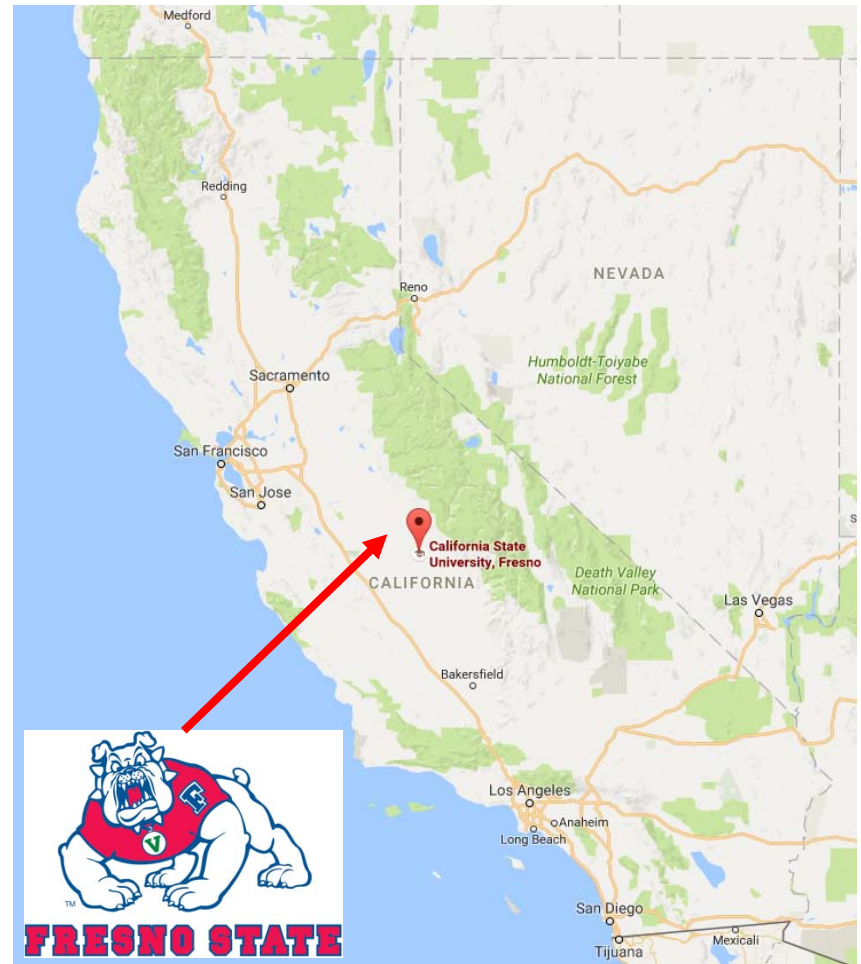
# AGENDA

- FRESNO STATE QUICK FACTS
- REASONS FOR UPGRADE
- UPGRADE GOALS
- PROJECT TEAM
- UPGRADE RESULTS
- LESSONS LEARNED



# FRESNO STATE QUICK FACTS

- 1 of 23 campuses in California State University system
- Central California
- 388 acres Main Campus
- 1,011 acres University Farm
- 24,136 students / 2,334 staff (2015)



# REASONS FOR UPGRADE



- Aging electrical infrastructure, installed in 1960s
- **Operator safety concerns**
- Mixed electrical systems of 4.16kV and 12kV
- **Capacity issues due to campus growth and new buildings**
- Major outages on somewhat regular basis every 6-12 months
- **Long restoration times anywhere between 8-72 hours**



# REASONS FOR UPGRADE



01/01/2013: Failed main switch leads to campus-wide, 3-day outage

# UPGRADE GOALS

- Increase system reliability
- Improve operator safety
- Reduce power restoration times
- Implement future-proof solution to accommodate campus growth
- Add remote monitoring and control capabilities
- Deliver turnkey solution

# PROJECT TEAM



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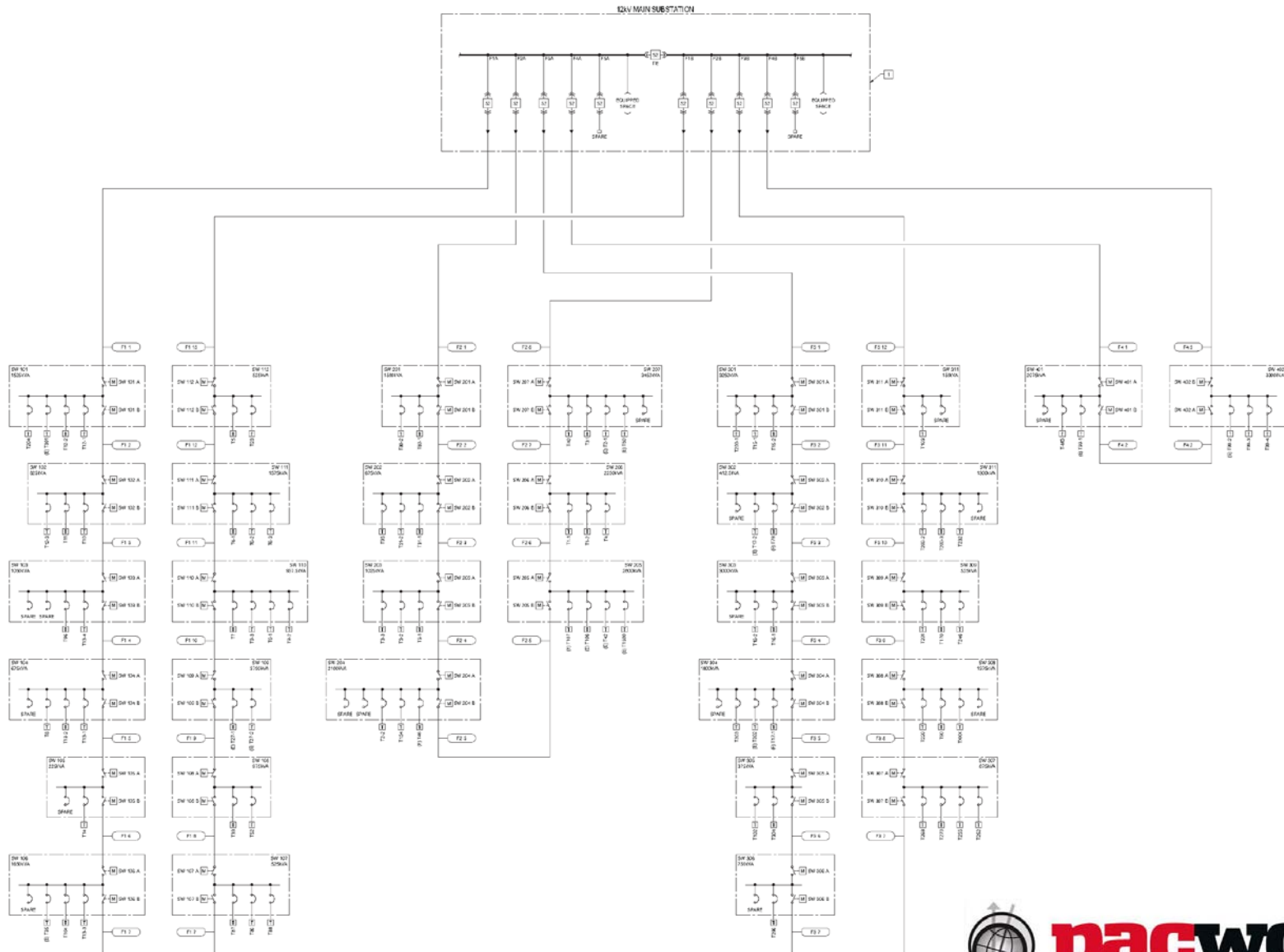
# UPGRADE RESULTS OVERVIEW

- 12kV loop feeder distribution system with 4 distribution loops + spare



# UPGRADE RESULTS

## NEW 12kV OPEN LOOP SYSTEM



# UPGRADE RESULTS OVERVIEW

- 12kV loop feeder distribution system with 4 distribution loops + spare
- Qty. 32 padmount switches with relays for protection and control

# UPGRADE RESULTS

## PADMOUNT SWITCHES



# UPGRADE RESULTS

## OVERVIEW

- 12kV loop feeder distribution system with 4 distribution loops + spare
- Qty. 32 padmount switches with relays for protection and control
- **New main switchgear building**
  - Arc-resistant, metal-clad 12kV switchgear with feeder protection relays
  - Control cabinets with redundant RTU and substation computer for HMI
- Qty. 60 manholes
- Qty. 68 12kV building transformers

# UPGRADE RESULTS MAIN SWITCHGEAR BUILDING



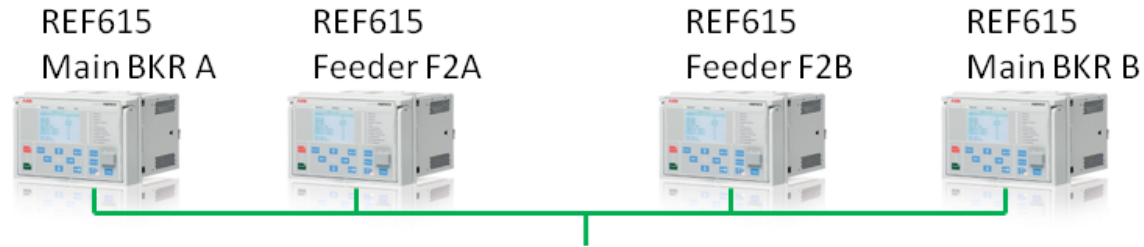
# UPGRADE RESULTS

## 12kV SWITCHGEAR & CONTROLS

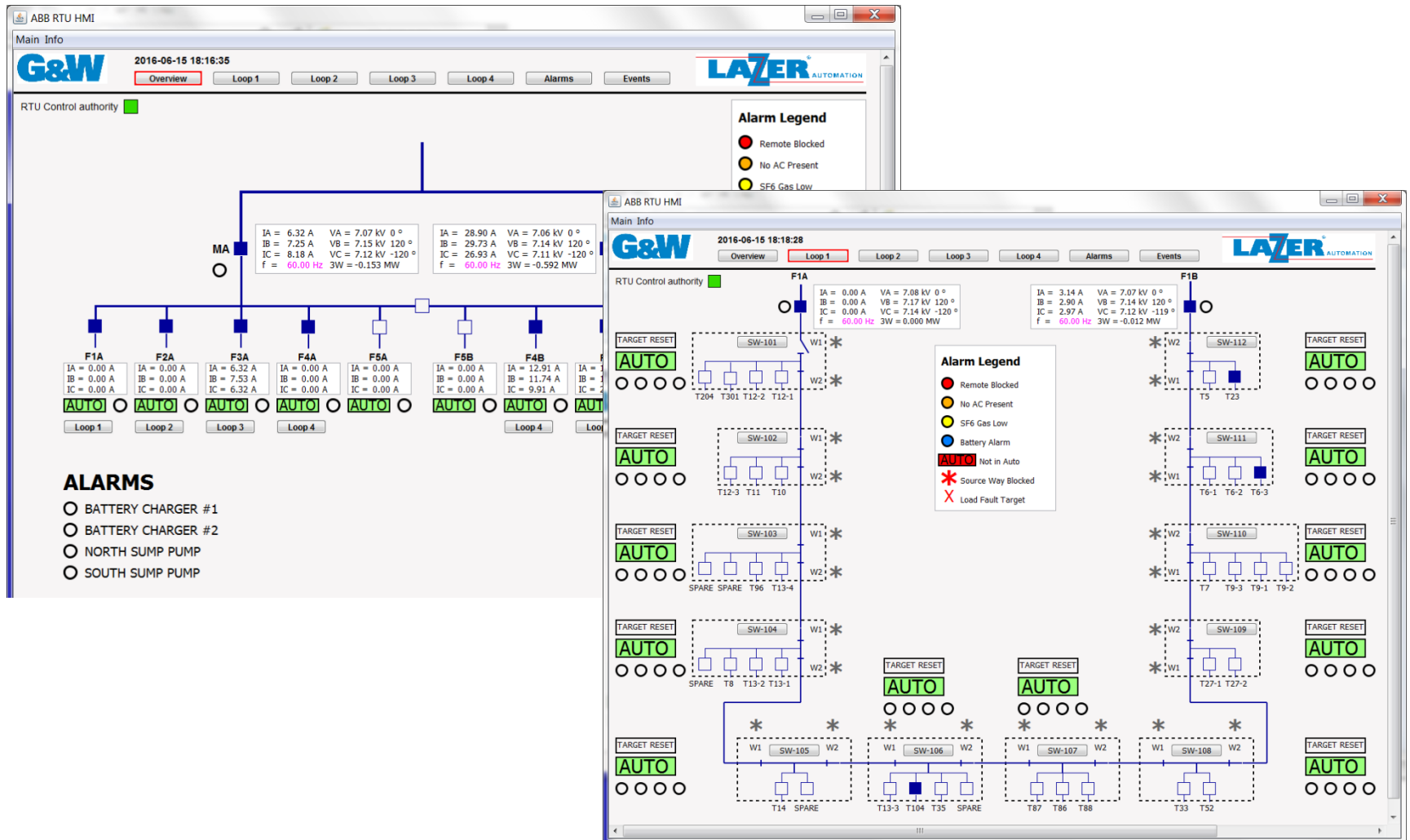


# UPGRADE RESULTS

## COMMUNICATIONS & CONTROLS



# UPGRADE RESULTS HUMAN MACHINE INTERFACE





# UPGRADE RESULTS

## STATE-OF-THE-ART SOLUTION

- Open loop automation scheme with FLISR and LOV functionality
  - Reduces power restoration times  
**from hours and days to seconds**
- Remote monitoring and control via HMI from substation building and office
  - Improves operator safety
- Best-in-class components
  - Increases system reliability
- Communication via multi-mode fiber ring using IEC 61850 and GOOSE messaging
  - Open protocol supports future-proof solution

# LESSONS LEARNED

## COORDINATION & PLANNING


- Project specifications vs. end-user expectations
- Construction drawings with dimensions for padmount switches and transformers
  - Bolt-down locations and space for control cabinets
- Planning for commissioning, testing, start-up
  - Outage schedules
- Factory Acceptance Test (FAT)

# LESSONS LEARNED

## COLLABORATION & COOPERATION

- Power for switch controls
  - Generators vs. energizing loops
- Availability of test sets
  - Current and voltage injections
- Operator training

# LESSONS LEARNED



**TEAMWORK**  
makes the  
**DREAM WORK**

**-- John C. Maxwell --**



**THANK YOU!**

