


SRP Value of Asset Health Monitoring

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NASPI January 2024 Webinar

SRP Asset Health Monitoring with PMUs

- Transformer Through Fault Assessment
- Potential transformer monitor
- System-wide large transformer failure research via Signal-to-Noise Ratio of ambient PMU data (ASU/SRP research project)

Transformer Through-Fault Monitoring

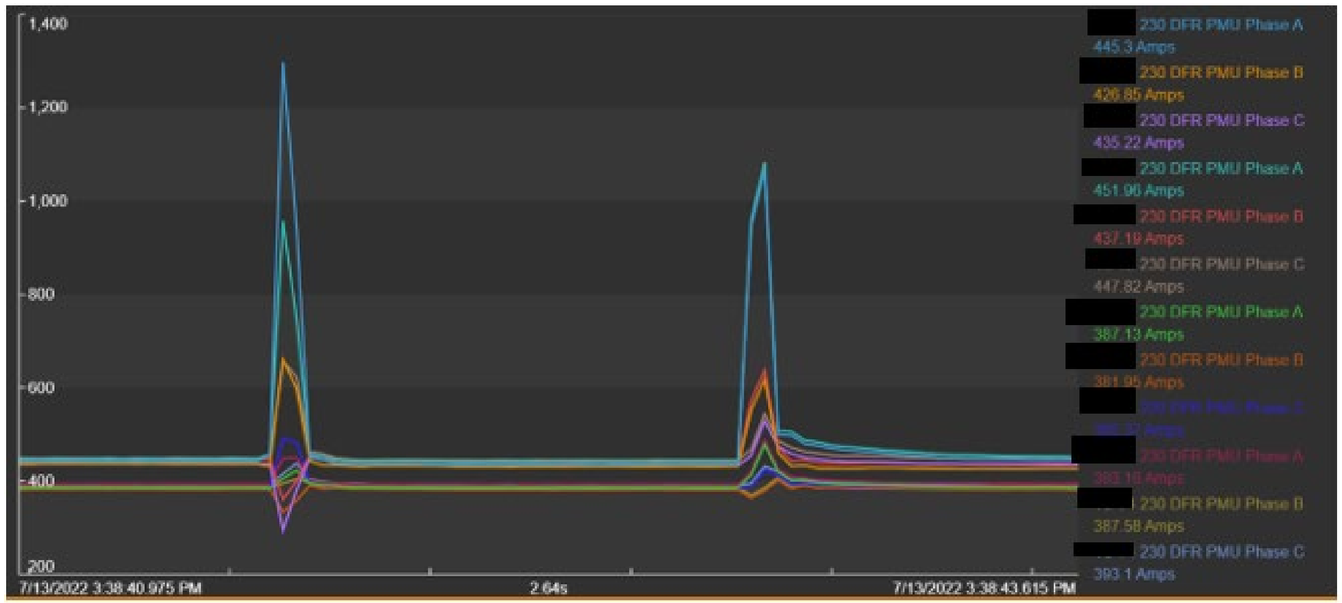
- SRPs Asset Optimization group has developed risk assessment criteria for large system transformers to evaluate degradation in life and triggering for replacements based, partly, on how much through fault current transformers are exposed to.

- Previously, SRP has had to count system faults, but now, PMU data has provided a more granular statistic to improve this risk assessment.

Transformer Through-Fault Monitoring

SRP Testimonial:

Capturing transformer through fault magnitude and duration using PMU data is Asset Optimization use case to improve our existing transformer probability of failure score algorithm. Shown below is a recent line A-B fault on a 69kV line connected to a 69/230kV substation with multiple 69/230 transformer banks on 07/13/22 at 15:38:41 PM. Without PMU data we are not aware that our local transformer A phase high voltage winding at 230 kV experienced through fault forces. How many accumulated through fault forces that exceeded 2.5 per unit of MVA base current before this transformer bank will fail? We have no data to answer that kind of question. Thankfully using data from DFR PMU in the future we will be able to answer that kind of question and associate it to our failure root cause analysis report.



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Instrument Transformer Monitor

- SRP has installed SEL's Synchrowave Operations software configured to display transmission asset information including transmission lines, transformers and switchgears.

- No notifications were setup to monitor instrument transformer PMU signals for potential failures.

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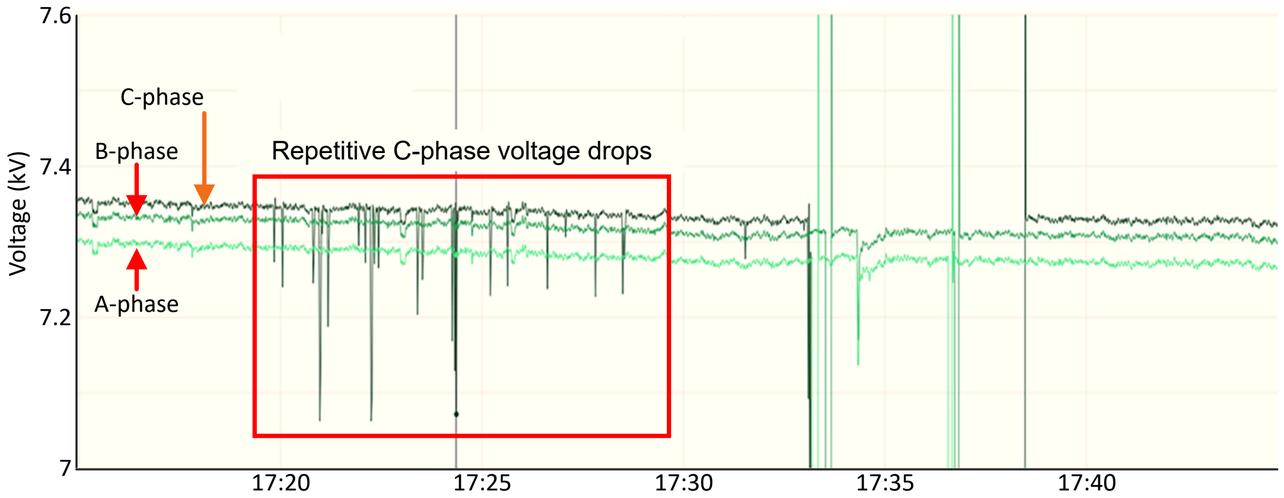
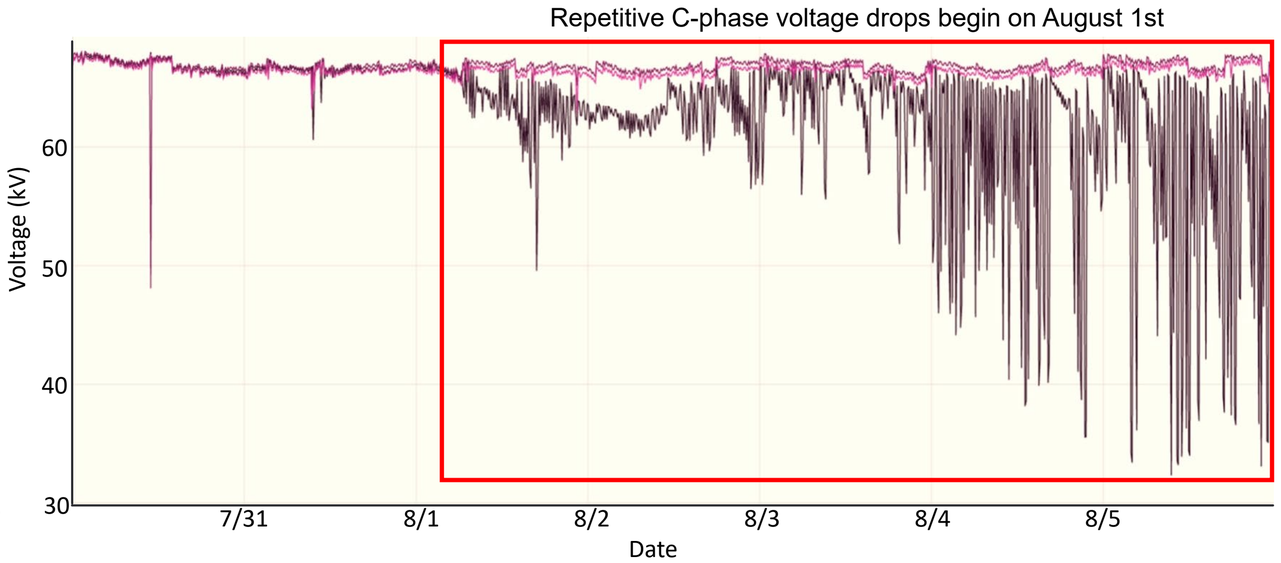
Instrument Transformer Monitor

SRP Testimonial:

Random checking of Synchrowave Operations assets revealed intermittently failing PT signals at two sites in SRPs system. One on a 12kV switchgear and the other on a 115kV PT. Failure modes risks range from failed secondary fuses leading to questionable voltage signals to downstream relays to PT equipment failure leading to possible catastrophic equipment failure. SEL has created an Instrument Transformer Monitor application within Synchrowave Operations to provide notifications of such events.





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Signal to Noise Ratio (SNR) Transformer Failure Detection

- Using PMU data from across SRPs system, research was performed by ASU to look at the Signal to Noise Ratio (SNR) of current and voltage signals was in 2019 and 2020 to determine if asset failures could be detected just from the SNR of the PMU signals. In 2019 the 2007 a 500/230kV transformer fire was investigated followed in 2020 with additional system failures. Proposed additional research is to vet the algorithm with additional asset failures as well as develop a failure locating algorithm to triangulate the area of the system with potential failures, possibly down to the substation.

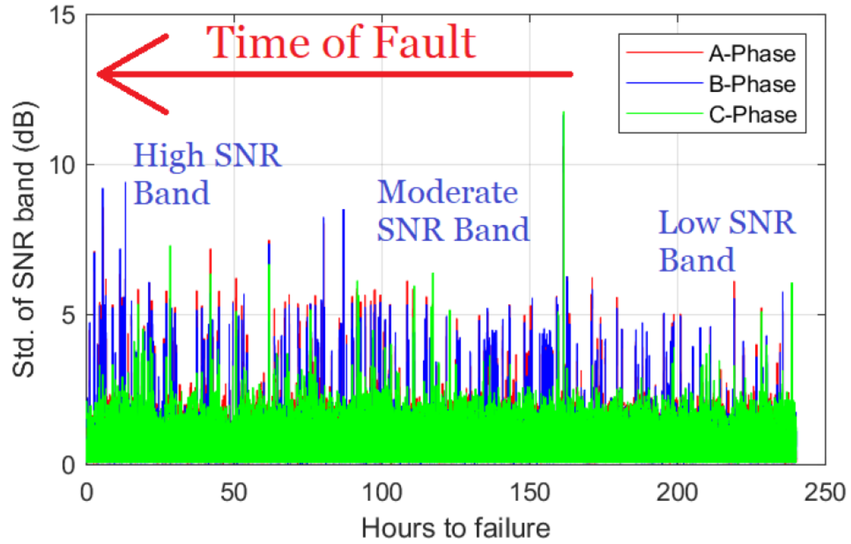

Fig. 3.5: Variations in standard deviation of SNR of real components of phase current from substation S_2 10 days away from the time of failure

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