

# IEEE PSRC “I” SC WG22 and WG27 Updates

Bob Beresh

Chair – I22, Chair – I27

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# Presentation Roadmap



- I Subcommittee WG 22 – End of “Useful” Life

- Background

- Need

- Issues

- So What?

- I Subcommittee WG 27 – Relay Self-Monitoring

- What is the problem?

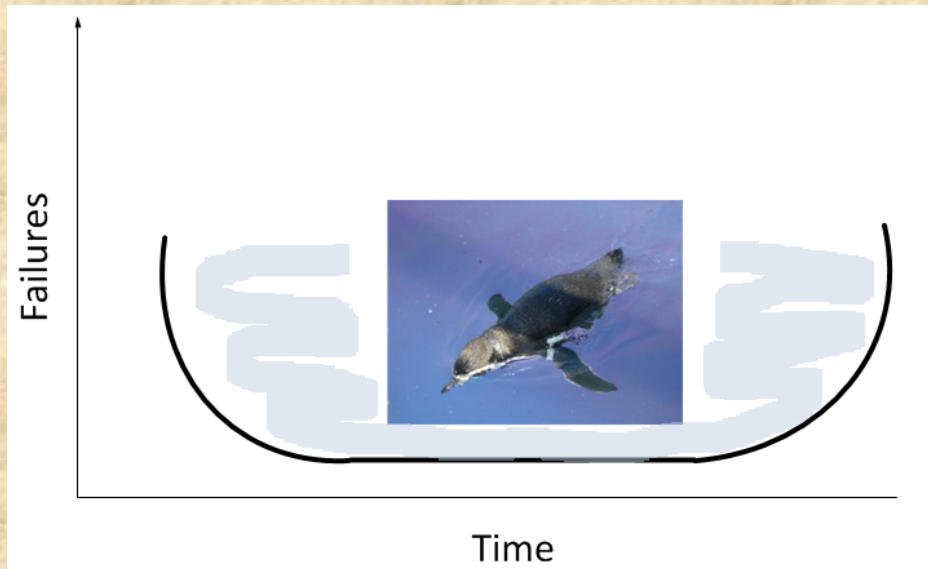
- Why are we looking at this?

- How are we going to deal with it?



## “End-of-Life Assessment for Protection and Control Devices”

Most of us are familiar with the ubiquitous bathtub curve...



...But do we always run our equipment to the end of its physical life?



“End-of-Life Assessment for Protection and Control Devices”

**...Useful Life...**

*Prepare a PSRC report on the criteria for determining the end-of-useful-life for protection, control, and monitoring devices including electromechanical, solid-state and microprocessor-based devices*

## Other industries...



### Finance...”depreciation recovery”...IRS

Property Class	Business Equipment
3 year	Tractors and horses over 2
5 year	Car, computer, copier, cattle
7 year	Office furniture
15 years	Land improvements, roads, bridges
39 years	Non-residential real estate

Property evaluation – Fannie Mae – “Estimated Useful Life (EUL) Tables”

NASA – RUL (remaining useful life)

# IEEE PSRC I SC WG 22



How do we determine end-of-life re P&C equipment?

Bathtub curve?

Typical expectations?

- Design Life
- MTBF
- Run-to-Fail
- Asset replacement models
- Manufacturer Data
- Reliability Analysis



# ..the reality is...



But – is this what really happens??

- Everyone know that stuff can and does get replaced before it “needs” to, or is “planned” to... (just consider your [or your wife’s] wardrobe; your last cellphone; or why you were forced to buy a new digital TV even though your analogue unit was perfectly fine).
- So too with P&C equipment...

There are various reasons for nixing something before its “time”...



# time to upgrade...



Vendor no longer supports product → obsolete:

Can't get new devices

Can't get spare parts

Can't get support

Goes out of business...



Does not have required capabilities:

Recording, Oscillograph

Networking, Security

Logic capabilities

Self-monitoring, etc.





# out with the old...



Upgrading other equipment (breaker replacement)

Government regulations (NERC PRC-005-002, CIP) (again, recall your perfectly good analogue TV...)

Environmental issues (exposed to high temp/humidity)

Loss of documentation/expertise

Increasing number of failures

Excessive f/w changes

Safety issues...



# ...now what?



So what? What are the implications of a sooner-than-expected-end-of-life?

Asset model needs to be updated

Impact on staffing - need more (less?) FTE/contractors

Customer/stakeholder satisfaction

Reliability

WEEE – where are you going to put it?

# Help! How do I cope...?



## What can we do?

Plan for early retirement of devices

Monitor/maintain vendor relations – stay in the know

Service Bulletins

Plan to re-evaluate the life expectancy of devices

Extend life of devices

Trends in other industries (Ethernet speed/61850/cloud computing/cesium clocks/wi-fi/MS Windows/etc.)

Environmental testing (humidity/temp)

# ...what else can I do?



Sample testing (nuclear)

What standards under development (NPCC, etc.)

Currently looking at the possibility of quantifying the above

Look at your own statistics! Monitor performance.

...a lot of things are easy to consider and are free...



...plan ahead!



Know what you want and how you are going to get it...



Next...



## Investigation of Relay Self-monitoring Capabilities

- The Problem – NERC PRC-005-2
- The Solution (or at least part of the solution) – IEEE WG I27

*Prepare a technical report to the PSRC main committee on the enumeration, performance and efficacy of self-monitoring capabilities within protective relays in order to determine the extent and degree of self-monitoring.*



Supplementary reference and FAQ – PRC-005-2 – Oct 2012

- “Microprocessor relay proponents have cited the self-monitoring capabilities of these products for nearly 20 years. Theoretically, any element that is monitored does not need a periodic manual test. A problem today is that the community of manufacturers and users has not created clear documentation of exactly what is and is not monitored.”
- “To utilize the extended time intervals allowed by monitoring, the user must document that the monitoring attributes of the device match the minimum requirements...”
- “Until users are able to document how all parts of a system which are required for the protective functions are monitored or verified...they must continue with the unmonitored intervals...”



Devices have self monitoring – but...

What do they monitor?

How effective is that?

Is that enough? Is everything covered?

What happens when there is problem?

How to deal with legacy devices?

“Physician, heal thyself”

Testing methods for self-test functions?

What requirements do utilities need to indicate that products have self-monitoring and how that works and what it covers?

Do not throw caution to the wind...





# More self-monitoring



Direct  
Methods

Component Failure	Monitoring Capability	Detail
RAM Failure	Yes	Static RAM read/write error
ROM Failure	Yes	EPROM program memory checksum error
Analog to Digital Failure	Yes	Analog to digital converter error
DSP System Failure	Yes	The watch-dog repeatedly attempts to re-start the DSP for diagnostic purposes.
μP Failure	Yes	Microprocessor exception or self-test error
Watchdog Failure	Yes	Microprocessor watchdog circuit timed out
Default Setting Loaded	Yes	Relay using default setting.
Password access Lost	Yes	Password access lost. No changes
Group Override	Yes	Setting group override in effect
Settings Change	Yes	Setting change made by a user
Active Setting Group Change	Yes	Active setting group changed
Self-Test	Yes	The most comprehensive self testing of the relay is performed during a power-up. During both startup and normal operation, the CPU polls all plug-in modules and checks that every one answers the poll.
Critical Failure Alarm	Yes	The relay has form-C contacts and is energized under normal operating conditions. The critical failure alarm will become de-energized if the relay self test algorithms detect a critical failure.
Output Override	Yes	One or more output contacts have logic override condition
Output contact Monitoring - Active Voltage Monitor Circuit	Yes	This circuit is connected across form-A contacts. The voltage monitor circuit limits the trickle current through the output circuit. The state of the operands can be used as indicators of the integrity of the circuits in which form-A contacts are inserted.
Clock Error	Yes	Real-time clock not set



# Our experience...

Relay goes to “sleep” with no indication that it is not working

Virtual outputs operate with no event record of reason why...

Plus, plus...



# Say what?



Hydro One Relay RFP (under development)

## Device Monitoring and Diagnostics (Continuous Device Internal Monitoring)

1. The device shall be equipped with general self diagnostic capabilities to continuously monitor the integrity of the device, including hardware, firmware and settings.
2. A major self-test error shall be defined as any error or failure that may result in either the IED being unable to execute it's primary function (e.g. failing to trip) or the IED acting in an unpredictable or undesirable manner (incorrectly tripping).
3. A minor self test shall be defined as...
4. The failure of any diagnostic self-test, regardless of severity, shall create an event to be recorded in a nonvolatile device event list.



5. The occurrence of a major self-test shall quickly and safely remove the IED from service...
6. The vendor shall describe in detail all of the continuous monitoring within the device...
7. The IED shall continuously monitor the health and availability of all Ethernet LAN ports.
8. The IED shall be able to detect the failure or unavailability of an Ethernet port that is connected to a LAN...
9. The IED shall continuously monitor...digital teleprotection interfaces for overall health.

Specify what you want now so

that you won't get burned later...





Questions?



All photos courtesy of Fourmilab ([www.fourmilab.ch](http://www.fourmilab.ch))