Énergie NB Power

Point Lepreau Generating Station

Upgrading to Rosemount 315X Transmitters:

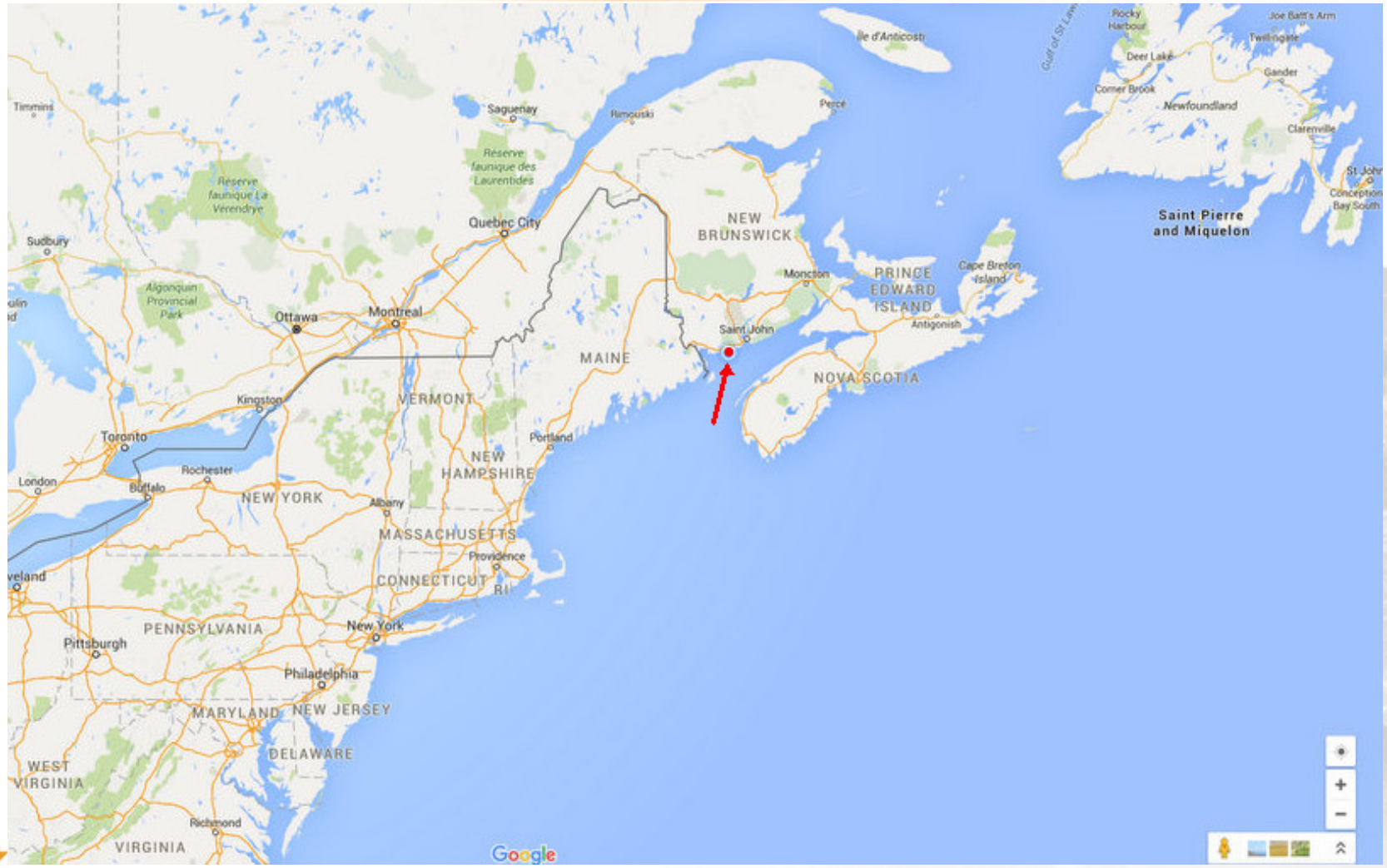
A Plant Perspective




Point Lepreau Generating Station

- Located near Saint John, NB, Canada on the Bay of Fundy
- Went critical in 1982
- Shut down for 18 month refurbishment in 2008.
- Started up again in 2012.

Point Lepreau Location



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My History

- Started at Point Lepreau in 1989, straight out of University.
  - Working in Instrumentation Calibration
  - Fledging EQ program
  - Mercury Wetted Relays
- Moved on to 4 years in Safety Systems
- Returned to the EQ group in 1996

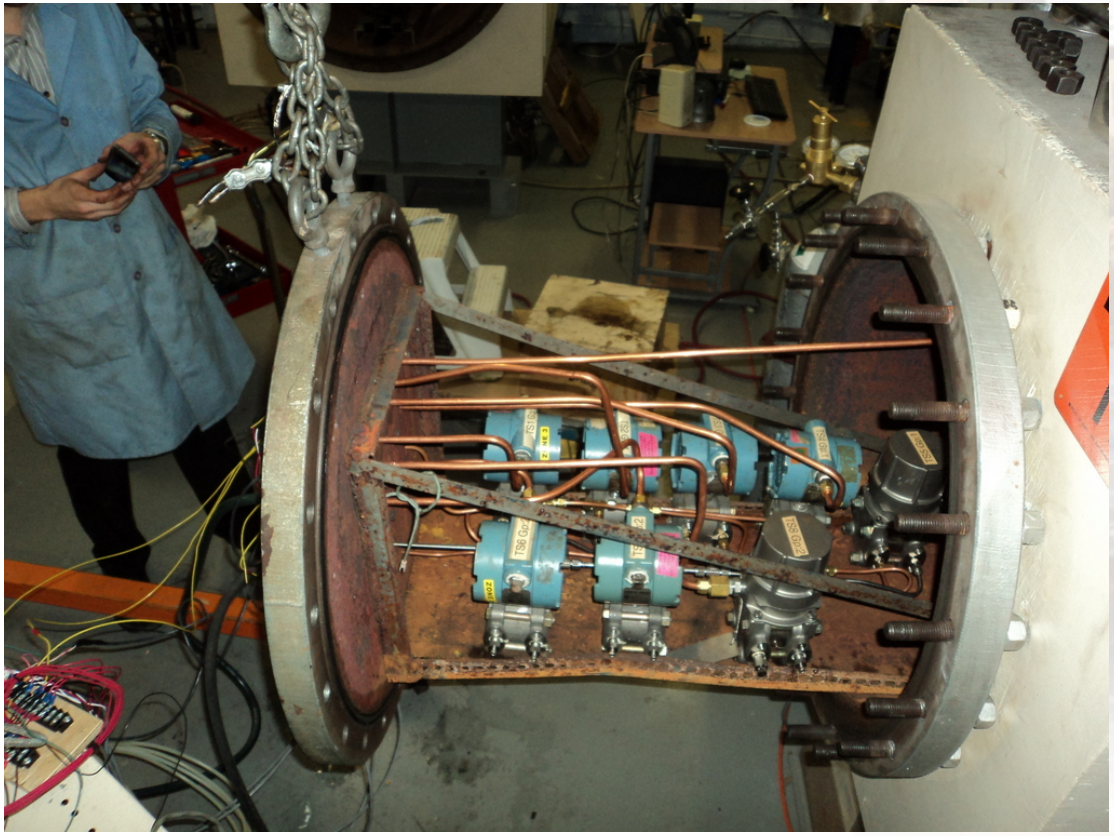
- You can't get out of EQ....

Rosemount Transmitters at PLGS

- 182 EQ'd transmitters
  - 131 Short Mission time (<8 hours)
  - 51 Long Mission time (90 days)
- 1152 model transmitters were used
- Qualified through testing to PLGS conditions in 1994
  - Qualified life running out in 2016

Requalification Attempt

- In 2012 We attempted to buy some time by testing field-aged transmitters.
- Results were not as good as we'd hoped for.



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2011 Test Results

- Test Report Summary:
- "The Rosemount 1152 Test transmitters were not able to operate within the stated acceptance criteria of +/- 1.875 in H_2O, however given the stressors imposed on these already field aged and used transmitters, as well as a total of three [Simulated] Design Basis Accidents, they proved operable throughout the entire test program. They show that even when significantly beyond end of service life conditions, they remain reasonably accurate and dependable."
- Observed Errors of up to 1.5%

2011 Test results cont.

- We chose not go continue with trying to qualify our existing transmitters.
  - Obsolescence issues
  - Failed test
  - Our failure to change circuit boards at the recommended 10 year interval

3152 Selection

- We chose to go with Rosemount 3152 transmitters for short mission time locations.
- Within our existing Safety Analysis numbers (<6 MRad)
- Transmitter Accuracy better than existing 1152s at these conditions

3154 Selection for Long Mission Times

- Our Normal + Accident Radiation expected dose is 10.5 MRad for a 90 Day Mission time.
- 3153 is qualified for the expected conditions, however the accuracy numbers are not as good as our safety analysis credits.
- 3154 has better accuracy numbers at 60 MRad, (.25% URL +0.8% span)
- Total of 51 Long Mission Time Transmitters.
- Extra cost of transmitters significantly less than cost of redoing safety analysis to accommodate decreased accuracy.

Steps remaining

- Get budget finalized
- Prepare generic design package
  - Will officially evaluate replacement selection and prepare generic documentation
    - Specification Sheets
    - EQA
    - Safety Analysis
  - Allow order to be placed for transmitters to be delivered over 2 years.

Specific Design

- Prepare individual packages for groups of transmitters
  - A “Non-Identical Replacement Item” package
  - Revise and Standardize calibrations
  - Instrument Application Sheets
  - Instrument Lists
  - Master Calibration Sheets
  - Drawings
  - Design Manuals
  - Installation Packages

Challenges

- Budget
- Upper management understanding of issues
- Questionable calibrations

Calibration/Maintenance Issues

- Manufacturer changes
  - Transmitter Ranges are different
  - Static Pressure Correction is not required for ranges 2 and 3
  - No transmitter maintenance required other than cover O-rings

- Plant Changes
  - Use this as an opportunity to standardize some calculations
  - All shop calibrations are now done in kPa/Mpa

Canada eh?

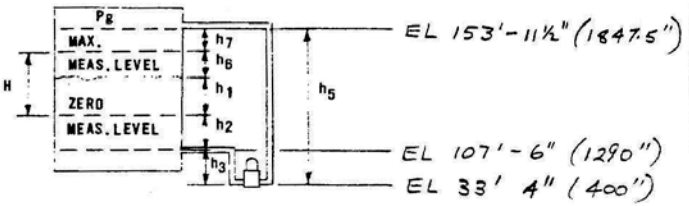
- Elevations in ft-in
- Fluid is D_2O
- Converted to "H_2O at 68°F
- Converted to kPa
- Final reading in m of D_2O

ATOMIC ENERGY OF CANADA LIMITED
Power Projects, Sheridan Park Research Community
Mississauga, Ontario L5K 1B2

INSTRUMENT APPLICATION SHEET
(WET LEG LEVEL TRANSMITTER)

TITLE *DIFFERENTIAL PRESSURE LEVEL MEASUREMENT ON CLOSED TANK WITH WET LEG TRANSMITTER INSTALLED BELOW H.P. TAKE OFF.*	PROJECT 87 PT. LEPREAU	LOOP 68237 ✳
		SHEET 1 cont'd on
INSTRUMENT NUMBER 68237-LT-✳		REVISION Ø1

✳) -1D
-1E
-1F



1434

VERTICAL LEG "H" IS 557.5 INCHES, CONTAINING D_2O HAVING ρ OF 47.1 LBS/FT³ @ A PSIG & 590 °F

" " h_1 "		"	"	" " "	"	" "
" " h_2 "	0	"	"	" " "	"	" "
" " h_3 "	890	"	"	" " " 69	"	" 100 "
" " h(5)"	1447.5	"	"	" " " 69	"	" 100 "
" " h(7)"	0	"	"	D_2O STEAM " " " 3.89	"	" 590"
" " h( )"		"	"	" " "	"	" "

NOTE: EQUATIONS ARE IN INCHES OF H_2O AT 68°F UNLESS STATED OTHERWISE

$H \frac{\rho H}{\rho W} = (557.5)\left(\frac{47.1}{62.28}\right) = (421.6)$

$h_1 \frac{\rho H}{\rho W} = (\quad)\left(\frac{\quad}{62.28}\right) = (\quad)$

$h_2 \frac{\rho H}{\rho W} = (\quad)\left(\frac{\quad}{62.28}\right) = (\quad)$

$h_3 \frac{\rho H}{\rho W} = (890)\left(\frac{69}{62.28}\right) = (986.03)$

OBSOLETE

APPLICABLE EQUATIONS: -

SUPPRESSION $P_s = h_3 \frac{\rho h}{\rho w} 3 + h_2 \frac{\rho H}{\rho W} + (H + h_7) \frac{\rho g}{\rho W} - h_5 \frac{\rho h 5}{\rho W} = (-582.8) = 986 + 557.5 \times \frac{3.89}{62.28} - 144.5 \cdot \frac{69}{62.28}$

RANGE = 0 to H $\frac{\rho h}{\rho w}$ - H $\frac{\rho g}{\rho W}$ $(386.8) = 421.6 - 557.5 \times \frac{3.89}{62.28} = 96.34\,kPa$

INSTRUMENT SUPPRESSION & RANGE

SUPPRESSION - $-582.8"\,H_2O = -145.17\,kPa$

RANGE IS - -145.17 to $-48.83\,kPa$ (CORRESPONDS TO MEASURED RANGE OF $0 - 14.16m$

NOTES

-145.17 to $-43.11\,kPa \equiv 0 - 15m$ (4-20mA)

~~WRONG~~ KEYED AT	TRANSMITTER ELEV'N INCORRECT @ 55'	1
	REVISION	
DESG'D F. Hwang	DATE 790410	
APP'D	DATE 10 Apr 79	

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First Principles Calculations

- $P=\rho gH$
- ρ is density of D_2O at the actual fluid temperature
- g is gravity
  - How accurate do you need it?
- H is head of liquid.
  - Based on elevations
  - How accurate are they, actually?
  - What about vessel expansion when hot?

New Application Sheet

- Using the previous elevations and densities, converted to SI.
- g obtained from Natural Resources Canada at a monitoring station in Moncton, 150km away.
- 9.80717 m/s^2

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Instrument Application Sheet

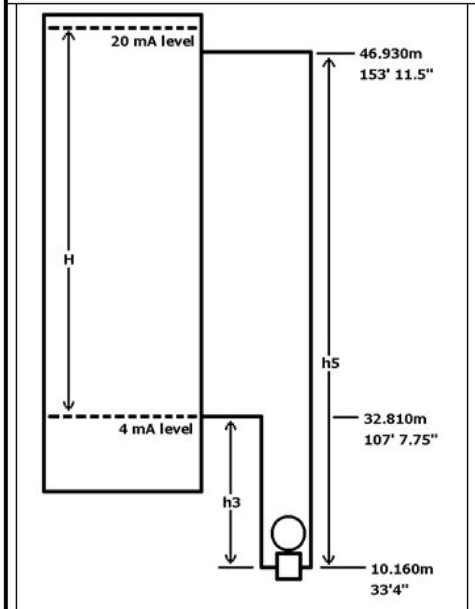
Form # PL-0902 Rev. 1 2014-05-06 Page 1 of 2

EQUIPMENT NUMBER: 68237-LT-1D/1E/1F

APPLICATION: SDS#1 Pressurizer Level

MODEL #/MATERIAL #: Rosemount 3152ND3A /

DOCUMENT NUMBER: 0087-68237-3000-001-IAS-A-01



Param	Height m	Density kg/m³	Temp °C
H	15.000	754.4	310
h3	22.650	1105.2	37.8
h5	36.767	1105.2	37.8
Steam		62.3	310

g	9.80717 m/s²

PREPARED BY: M.K. Steeves

Date (yyyy-mm-dd):

VERIFIED BY: D. Mihaileanu

Date (yyyy-mm-dd):

APPROVED BY: C.Miner

Date (yyyy-mm-dd):

Engineer's Stamp

New Application Sheet

- Calibrations were simplified
- No unit conversions
- All inputs and outputs shown
- Results were within about 1% of previous numbers.

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Instrument Application Sheet

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EQUIPMENT NUMBER: 68237-LT-1D/1E/1F

APPLICATION: SDS#1 Pressurizer Level

MODEL#/Material #: Rosemount 3152ND3A /

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$\Delta P_{4ma} = (\rho 5 * g * h5) - ((\rho h3 * g * h3) + (\rho Steam * g * H))$

$= (754.4 * 9.80717 * 36.77) - ((1105.2 * 9.80717 * 22.65) + (62.3 * 9.80717 * 15))$
$= 143.84$ kPa

$\Delta P20_{ma} = (\rho 5 * g * h5) - ((\rho h3 * g * h3) + (\rho H * g * H))$

$= (754.4 * 9.80717 * 36.77) - ((1105.2 * 9.80717 * 22.65) + (754.4 * 9.80717 * 15))$
$= 41.02$ kPa

Range of Transmitter is -143.84 kPa to 41.02 kPa

Notes:

1) The previous revision of this IAS used multiple conversions between Imperial and SI units, resulting in slight differences in final numbers.

2) Range 3 Rosemount 3152 transmitter will autocorrect for high static pressure, so no correction needs to be performed in this calculation.

3) Damping is not adjustable on this model of transmitter

Project Status

- Rosemount is anxiously waiting for a PO
- Still working out details of budgeting with our finance department
- Specification Sheets have been prepared
- Design package 80% complete
- Application Sheets in progress. ~30% prepared

Project Status: work remaining

- Individual design packages for groups of transmitters
- Sort through drawings to determine what needs updated
- Write the EQA to formalize Rosemount's numbers for PLGS
- Familiarize the shops with the new transmitters

Potential Hiccups

- Indication spreads during replacement
- High workload on shops
- Splicing new quick disconnects
  - Many existing transmitters use Namco
- Getting transmitters on site before we run out of spare 1152s
- Damping issues
  - Radiation Accuracy vs. need for damping.

Thanks to:

- Dinu Mihaileanu – NB Power
- Kevin Alto – Rosemount Nuclear
- Mario Deschenes – Atlantic Controls