NNI

4.0 Presentation

4.1 Introduction

4.1.1 Cover instrumentation block diagrams for RCS & secondary systems

4.1.2 Particulars of ICS inputs

4.2 RCS Temperatures

4.2.1 Locations (figure 11.1-1)

note: RPS and NNI NOT shared!

4.2.2 T_h (figure 11.1-2)

signal sources:

NNI RTD & bridge
ECI RTD & bridge

note: optical isolator

outputs:

non-selected to plant computer
NR indication (530F - 650F)
flow temperature compensation
input to Loop Tave
input to ΔT calculation
input to Unit T_h
input to Unit Tave
input to ICS BTU calculation
high temperature alarm (635F)

4.2.3 Wide Range T_c (figure 11.1-3)

signal sources:

NNI RTD & bridge
ECI RTD & bridge

outputs:

non-selected to plant computer
WR indication (50F - 650F)
RCP start interlock (500F)

4.2.4 Narrow Range T_c (figure 11.1-4)

signal sources:

NNI RTD & bridge
ECI RTD & bridge

outputs:

plant computer
NR indication (530F - 650F)
input to Loop ΔT calculation
input to Unit Tave
input to Loop Tave
input to average Loop T_c
input to ΔT_c calculation

(Loop A - Loop B)
FW demand ΔT_c control

4.2.5 ΔT (figure 11.1-5)

$\Delta T = (T_h - T_c)$
indication (0F - 80F) ... no control functions
sources: Loop A & Loop B

Unit ΔT = (Unit T_h - Unit T_c)

4.2.6 Tave

Tave = $(T_h + T_c) / 2$

sources:

Loop A
Loop B
Unit T_h
Unit T_c

outputs:

NR indication (530F - 650F)
ICS (reactor demand)

auto / man selector switch:

interlock ... auto selects Loop with highest RCS flow should RCS flow sensed in a Loop fall below 90%

4.2.7 Temperature summary (figure 11.1-17)

4.3 RCS flow (figure 11.1-6)

4.3.1 Location ... in each hot leg

4.3.2 Detector (figure 11.1-7)

flow tube
high side ... RCP discharge
low side ... static head
advantage ... minimum flow restriction
disadvantage ... unable to measure low flow

outputs: (figure 11.1-8)

indication (0 - 120 x 10^6 lbm/hr)
Tave auto / man selector switch
ICS ... Unit load demand (load limiter)
ICS ... FW demand (partial flow ops)

4.4 Pressurizer level (figure 11.1-9)

4.4.1 Signal sources ... ECI

4.4.2 Outputs:

non-selected to plant computer
high-high level alarm (350")
high level alarm (240")
low level alarm (200")
low-low level alarm & interlock (120")
recorder (0" - 400")
input to makeup control valve

4.4.3 Density compensated

$(H_{ref} \times D_{ref}) - (H_{var} \times D_{var})$

D_{var} is a function of pressurizer temperature

4.4.4 Level program (figure 11.1-10)

360" 90%

expansion on turbine trip

240" .....

insurge margin

220" ..... level setpoint

outsurge margin

200" .....

no HPI

0" ..... low level tap

4.5 Pressurizer Pressure (figure 11.1-11)

4.5.1 Wide Range

Signal sources ... ECI

Outputs:

non-selected to plant computer
recorder (0 psig - 2500 psig)
~~high pressure bypass~~ warning ~~(1920 psig)~~

4.5.2 Narrow Range Pressurizer Pressure (figure 11.1-12)

Signal sources:

NNI-X
NNI-Y

Alarms:

low (2095 psig)
high (2295 psig)

PORV:

open (2295 psig)
close (2270 psig)

Heaters:

~~Sumer~~ Summer vs. setpoint (2195 psig)
error controls heaters
PI control to SCR

4.6 Secondary Indications

4.6.1 Locations (figure 11.1-13)

4.6.2 Main feed flow (figure 11.1-14)

indication (0 - 9 x 10^6 lbm/hr)
plant computer
square root extractor
variable gain
temperature compensation
ICS FW demand

4.6.3 Start up feed flow (figure 11.1-14)

indication (0 - 2 x 10^6 lbm/hr)
plant computer
square root extractor
variable gain
temperature compensation
ICS FW demand

4.6.4 Feed temperature (figure 11.1-14)

indication (0F - 600F)
plant computer
RTD bridge
supplies temp compensation for FW flow
ICS FW demand (BTU limits)

4.6.5 Feed reg valve dp (figure 11.1-14)

indication (0 psid - 100 psid)
plant computer
ICS FW demand (MFP speed)

4.6.6 OTSG instrumentation (figure 11.1-15)

Start up level ... ICS input
Full range
Steam temperature ... superheat limits
(removed)

4.7 Smart Analog Signal System (figure 11.1-16)

4.7.1 Purpose

mitigate effects of ICS input failures

4.7.2 Operation

senses degraded input & auto transfers to operable input

two transmitter inputs designated A & B

A & B compared to 3% mismatch

if mismatch ... program determines rate of change of mismatched signal (by comparing with its previous value) ... if rate of change exceeds 30% per second program reiterates to verify failure ... if verified then auto selects operable transmitter and generates alarm