NPD G.S.

SYSTEM TRAINING MANUAL

050 - GENERAL

051 - SITE

052 - BUILDING

This manual is issued as an indoctrination course on the N.P.D. General, Site and Buildings & Structures. The successful completion of the course and examinations will, however, be required as partial NO4, NC4 or NM4 qualifications.

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Course 050
Lesson 050-001

NPD Systems - General

EQUIPMENT CODE

To identify systems, types of equipment and elements of equipment, the designer, for various reasons, developes a code that is a form of shorthand that permits him to name the above items on drawings, equipment lists, identification tags in the field, etc. Two fairly obvious reasons are that it saves time and space. Sometimes the designer forgets that his interest in a code is short-lived, a year to two, whereas the operators interest extends over many years.

The designers of NPD recognized that a code was needed that would be applied by all alike, that would be made up of letters and numbers and easy to apply and to remember. This code served their purposes well and in turn serves the purposes of the operators as well.

Application of Equipment Code

Each piece of equipment is identified by a combination of letters and numbers made up from five predetermined lists or groups.

Basically, the code for a given piece of equipment is made up from the first three groups only. The exception to this is instrumentation, and equipment controlled or modulated by signals from instruments. Groups 4 and 5 are therefore, only used to determine the code for instrumentation.

Since there are different rules for formulating the basic and instrument codes they will be dealt with in two separate sections.

Basic Code (Groups 1, 2 and 3)

Group 1 - Process System (one or more letters)

Group 2 - Type of Equipment (one or more letters)

Group 3 - Specific Identity (number only)

In the group 1 portion of the code, anywhere from 1 to 4 letters are used to designate the system. Generally these are the first letters of the full name of the system. e.g. DE stands for Distribution Electricity. As may be seen from inspection of the group 1 code list, one letter, usually the last, is a key letter denoting the type of system, e.g. A - air, E - electricity, H - heavy water, O - oil, S - steam, V - ventilation, W - water (light).

The group 2 portion of the code, except for G - generator, M - motor and V - valve, does not contain a key letter. Generally this section of the code is made up from letter(s) selected from the full name of the equipment. There are some exceptions, e.g. J - telephone and K - loudspeaker. Also, provision was not made in the original lists for every conceivable piece of equipment that might be installed and, some pieces that were installed were not included. As a result, some items, such as the anti-reverse mechanisms of the Primary Pumps, do not have a code assigned and in some cases there is duplication, e.g. HY stands for humidifier or hydrant.

The group 3 portion of the code is a simple numbering system used to differentiate between similar pieces of equipment in the same system, e.g. transformers, motors, pumps, valves, tanks, etc.

A hyphen is used to distinguish between group 1 and group 2 letters. Group 3 numbers are simply added after the group 2 letters.

Examples

Group 1	Group 2	Group 3
Process System	Equipment	Specific Identity
Primary Heavy Water	Pump	Number 1
PH	P	1
Coded Name - PH-P1		
Vault Ventilation	Fan Motor	Number 5
VV	FM	5
Coded Name - VV-FM5		
Helium Gas	Flame Arrestor	Number 2
HG	FA	2
Coded Name - HG-FA2		

Fuelling Machines

The Fuelling Machines and associated equipment are treated as an entity unto themselves and only follow the station coding system in some areas. Generally, these pieces of mechanical equipment which do have code names follow the station coding system. However, many of the components are referred to only by their full names.

Most of the equipment for changing fuel is duplicated. For example there are two new fuel ports, two carriages, two gates, two maintenance panels, etc. These are fixed assemblies, and whether they have code names or are referred to by their full names, the suffix east (E) or west (W) is added to differentiate between them, e.g. New Fuel Port West (no code name) or CF-P1-E (Changing Fuel Pump #1 East).

For interchangeable assemblies, such as the Fuelling Machine heads, a number suffix is added to separately identify duplicate items, e.g. CF-MV13-1 would be a particular valve on the #1 head. CF-MV13-3 would be the valve serving the same function on the #3 head.

In addition to the F/M's, Reactor components also have the suffix E or W affixed to their names to differentiate between duplicate items at opposite ends, e.g. G9E refers to Reactor lattice position G9 east end.

Instrumentation Code

When formulating a code for an instrument the group 2 letter I, which indicates that the type of equipment is an instrument, is omitted. The hyphen is also omitted.

A fourth group of single letters is used in the instrumentation coding to identify the measured variables. All of the letters of the alphabet except I and O have been used and insofar as is possible the code letter is the first letter from the full name of the variable.

Using groups 1, 3 and 4 we can now identify instruments by Process System and measured variable.

Examples

Group 1	Group 3	Group 4
Process System	Specific Identity	Measured Variable
Primary Heavy Water	Number 1	Pressure
PH	1	P
Coded Name - PH1P		
Process Water	Number 24	Flow
PW	24	F
Coded Name - PW24F		
Access Control - Building	Number 11	Radioactivity
AB	11	R
Coded Name - AB11R		

The code thus far is sufficient when referring to an instrument in general terms or when applied to a complete instrument train. However, the specific elements of instrument circuits must also be identified. Therefore, a fifth group of letters is used for element identification.

Since letters are used in both groups 4 and 5, a hyphen is inserted in the code between these two letters or groups.

If identical elements are used in the same instrument circuit they are numbered and the number appears in the code as a suffix after the group 5 letter.

Examples

Group 1	Group 3	Group 4	Group 5
Process System	Specific Identity	Measured Variable	Element Identicication
Primary Heavy Water	Number 1	Pressure	Recorder
PH	1	P	R
Coded Name - PH1P-R			
Moderator Heavy Water	Number 2	Temperature	Recorder with Retransmission
MH	2	T	RM
Coded Name - MH2T-RM			
Distribution Electricity	Number 2	Voltage	Fuse Number 2
DE	2	V	FU2
Coded Name - DE2V-FU2			
Reactor	Number 19	Radio-activity	Detector
R	19	R	D
Coded Name - R19R-D			

Some systems do not have variables. The Protective (PC) and Regulating (RC) Systems, for instance have variables associated with their functions but these variables are coded according to the system from which the variable signal originates.

The Flow and Temperature monitoring systems are treated entirely as instrument circuits. Certain elements of these systems are duplicated 132 or more times, there being at least one element associated with each fuel channel, and in many cases, spare elements.

To identify the individual elements the Reactor lattice code is used, e.g. $\frac{\text{PH1F-D}}{\text{A3}}$, this being the flow detector in channel A3. In many cases where elements have been arranged in groups, this code has been shortened for convenience in the field. For instance, the Temperature Monitoring

amplifiers, located in the Relay Room, are identified with the Reactor lattice code only. A3, A4, A5, etc. The Flow Monitoring transmitters, located in the Flow Monitoring Room are identified as follows; PH1F-A3, PH1F-A4, etc. The valves associated with these, and all other D/P cells, are tagged SV, EV, LV or HV, depending on their function.

When these elements are referred to in written reports etc., their full code name is used. e.g. $\frac{\text{PH1T-D}}{\text{A3}}$.

The Activity Monitoring System does not follow the same coding arrangement as the PH1F and PH1T systems. Although it is considered to be an instrument circuit of the Heat Transport System (USI 63313) this system bears the code AH.

Equipment associated with this system bears the coding AH-HX1 etc. Instruments bear the code AH1R, AH2R, etc. Pipe lines and valves used for connections to the individual channel feeders have the Reactor lattice identity inserted in their codes, e.g. AH-A3-L1, AH-M10-SV1, etc.

Control valves, by definition, are valves or dampers in fluid systems that allow flow; stop flow; divert flow or modulate flow on signal from instruments in order to control or regulate a process.

Valves or dampers which open or close with the starting or stopping of pump or fan motors are not normally considered control valves.

Control valves are not necessarily installed in the process system from which the control signal originates.

To identify these valves they are named according to the system in which they are installed and the name of the controlling instrument is inserted as a prefix, e.g. MH1T-PW-CV1, is the control valve which modulates process water flow to the Moderator heat exchanger on signal from MH1T. MH1T-D is located in the suction line of the moderator pumps. PW21P-PW-CV8, is the valve which regulates the pressure in the Reactor Area Cooling section of the Process Water System. The modulating signal originates from the same system in which the valve is installed.

Control valves are of course motorized valves but are designated CV. All other motorized valves are designated MV.

Many design groups were involved in the original station design and not all of these groups applied the code in the same manner. As a result the coding may appear inconsistent from system to system. For example, butterfly

valves used in the Boiler Room Dousing System are designated as CV while butterfly valves used in the Vault Ventilation System are designated MV, e.g. DSW13/14/15P-DSW-CV8 and DSW1/2/3P-VV-MV30.

In some instances more than one instrument or group of instruments exercise control of a valve. In such a case only the primary or most important instrument codes are used as the prefix to the valve code. For instance, if all the instruments associated with DSW1P-MH-CV2 were included in its code name it would look like this - DSW1/2/3/4/5/6/19/20/21/22/23/24/25/26/27P-MH-CV2.

Devices or switches which control the operation of pumps, motorized valves, etc, are classified as elements of instrument circuits and are designated "H". (Group 5 - element identification). These devices may be hand switches or controllers. Hand switches may be of several different varieties and controllers may be either manual or auto-manual.

If there is no automatic feature associated with a switch or controller the name is then coded according to the piece of equipment with which it is associated, e.g. IW-SC2-H is a hand switch in the Control Room used to start and stop #2 Travelling Screen in the Intake Water System. VV-MV33-H is the manual controller for the Reactor Vault to Boiler Room interconnecting damper.

If there is an automatic feature associated with a switch or controller the name is then coded according to the associated instrument train, e.g. V1F-H1 is the "off-on-auto" switch associated with V-FM3 which starts "auto" on low flow in the main building exhaust system. PH1H-H3 is the auto-manual controller for PH1H-PH-CV2 which is one of the valves associated with Surge Tank level regulation in the Heat Transport System.

Again, many different groups were involved in the initial design and as a result the code has been applied in a different manner from system to system. For instance, Process Water pumps, which start automatically on low pressure when their switches are in the "auto" position, have their hand switches coded PW-PM1-H, etc. The main condenser overboard valves manual controller, which has no automatic feature, is coded CW1F-H.

Most hand switches associated with the Regulating, Protective and Activity Monitoring Systems have been coded as equipment rather than elements of instrument circuits, e.g. PCS-SW1 is the Reactor Power State Selector switch. PCT(A)-SW3 is the selector switch associated with protective channel "A" trip test facility. AH-SW6 in the Activity Monitoring System is #1 scanner speed adjustment.

Key operated switches in the Regulating and Protective Systems have been termed locks (LK) except the "manual air to Regulating valves" switch which has been coded RC-PA-H.

The auto-manual controllers for the Regulating Valves have been coded after the valve position indicators rather than after the modulating variable signals.

These, and other inconsistencies in the application of the coding system are not insurmountable obstacles but do make the job of learning the code more difficult. Since it is not always possible to deduce the code for a particular device by applying the basic coding rules it becomes necessary to learn by association and eventually memorizing these various code names.

Attached to this lesson are the indexes for the five code groups.

Revised by: R. Whitney

INDEX FOR GROUP 1 - PROCESS SYSTEM

A. air

- CWA - circulating water extraction air
- EA - extraction air (from cond. air extraction system)
- GA - generator air (generator cooling)
- PA - process air (compressed air for instrumentation, etc.)
- VA - atmospheric vents (air, steam, etc.)

B. building

- AB - access control - building
- CB - contamination control - building
- FB - fire protection - building
- VCB - vault concrete - building

C. control

- PC - protection control
- PCS - protection control start-up
- PCT - protection control test
- RC - regulating control

D. drainage

- AD - active drainage (containing potentially active drains)
- DD - domestic drainage (showers, sinks, etc.)
- PD - process drainage (outlet from heat exchangers, coolers, etc.)

E. electricity

- DE - distribution electricity
- GE - generation electricity (turbine generator output system)
- LE - lighting electricity (plant lighting)

F. fuel

- AF - assembly fuel
- BF - booster fuel
- CF - changing fuel
- EF - examination fuel
- SF - storage fuel

G. gas

- CG - carbon dioxide gas
- FG - freon gas
- HG - helium gas (helium pressure system)

H. heavy water system

- AH - activity monitoring heavy water (primary circuit)
- CH - collection heavy water (from known leakage points

H. heavy water system (cont'd)

DH - drying unit heavy water
DSH - dousing heavy water (Reactor Vault)
GH - general heavy water
LH - leakage heavy water (leak detection, etc.)
MDH - moderator demineralizer heavy water
MH - moderator heavy water
PDH - primary demineralizer heavy water
PH - primary heavy water (main coolant system)
PRH - primary relief heavy water
RH - recovery heavy water (recovery of escaped D_2O)
SH - standby heavy water (standby to PH)
VH - air wash heavy water (vault cooling scrubber, etc.)

K.

SK - sampling system

L.

MCL - makeup chlorine (to water treatment plant)
PCL - process, domestic and circulating chlorine
SCL - sewage chlorine (to sewage)
ML - multiple system
TL - turbine lubrication

M.

CM - communication

N.

AN - annunciation
LN - liquid nitrogen

O. oil

FO - fuel oil (building heating)
MLO - moderator pumps lubricating oil
MSO - moderator pumps sealing oil
PLO - primary pumps lub. oil
PSO - primary pumps sealing oil
VSO - ventilation fans sealing oil
VVSO - vault ventilation fans sealing oil

P.

Q.

R. reactor

S. steam

BRS - boiler relief steam (from boiler)
ES - extraction steam (from turbine)
RJS - reject steam (to reject condenser)
TS - turbine steam (from boiler)
GS - gland steam (to turbine glands)
RFS - reflector steam
PCS - see control

T. turbine

MT - meteorological
PCT - see control

U.

V. ventilation

VV - vault ventilation (vault cooling)

W. water

BBW - boiler water (blow down or blow off)
BYW - bay water (spent fuel bay)
CFW - chemical feed water
CW - circulating water (condenser)
CCW - concrete cooling water
DMW - domestic water (showers taps, etc.)
DSW - dousing water (light water dousing)
EW - extraction water (condensate from extraction steam)
FW - feed water (condenser to steam generator)
GW - gland water (turbine glands)
HW - heating water (building heating system)
IW - intake water (intake to pump house)
MW - makeup water (demineralized water)
PW - process water (to process equipment)
RFW - reflector water
RJW - reject water (from reject condenser)
SW - standby water (from fire pump)
SDW - steam drain water
VSW - valve sealing water
IJW - injection water(emergency injection to Primary System)

X.

Y.

Z.

INDEX FOR GROUP 2 - TYPE OF EQUIPMENT

A - amplifier
AG - agitator
AN - annunciator

B - breaker
BD - bursting disc
BL - bell or horn
BO - boiler
BU - burner
BR - bearing
BY - battery

C - conduit
CD - condenser
CF - clarifier
CL - cooler
CP - compressor
CR - crane
CAP - capacitor
CT - current transformer

D - disconnect
DR - dryer
DS - desuperheater
DA - deaerator

E - engine
EJ - expansion joints

F - fan
FR - filter
FB - flash box
FC - fluid coupling
FA - flame arrester
FU - fuse

G. generator

DG - diesel generator
TG - turbine generator
MG - motor generator
SG - steam generator

when the type of equipment is suffixed by "G", this indicates generator

GT - grounding transformer

HD - header
HR - heater
HX - heat exchanger
HY - humidifier or hydrant

I - instrument
IL - indicating
IX - ion exchanger

J - telephone

K - loudspeaker
MK - microphone

L - line
LA - lightning arrester
LK - door lock or lock assembly
LS - limit switch
LU - lubricator

M. motor

BM - burner motor
CPM - compressor motor
FM - fan motor
PM - pump motor
GM - generator motor
SHM - shield motor

when the type of equipment is suffixed by "M", this indicates motor.

N
NP - nozzle plate
NZ - nozzle

O
OR - orifice

P - pump
EP - extraction pump
PL - panel
PT - potential transformer
PR - printer
PS - power supply

Q

R - relay
RC - receiver
RE - receptacle
RES - resistor
RF - rectifier
RG - resistor-grounding
RT - reactor (electrical)
RU - recombination unit

S
SB - scrubber
SD - steam drum
SL - silencer
SP - separator
SS - sample station
ST - strainer
SW - switch
SR - starter
SC - screen
SU - support (for pipe
SPG - spark gap

T - transformer
TK - tank
TU - turbine
TP - trap
TY - trays
TN - turning gear

U - unit

V. valve

CV - control valve (automatically modulated)
MV - motorized (air, solenoid, motor, piston)
RV - relief valve
SV - safety valve
NV - non return valve
PLV - pressure limiting valve
XV - special valve
MXV - motorized special valve

when the type of equipment is suffixed by "V", this indicates valve.

W

X

Y

Z

Group 3 - Specific Identity

1. Number of units serving identical functions

2. etc.

3. etc.

INDEX FOR GROUP 4 - VARIABLES MEASURED
(for instrumentation only)

A	-	current (amperes)
B	-	thermal power (BTU)
C	-	conductivity
D	-	density
E	-	eccentricity
F	-	flow
G	-	weight (gravity and gas analysis)
H	-	height (fluid level and position)
I	-	
J	-	mechanical position (valves, doors, shafts, differential expansion)
K	-	power factor
L	-	leak
M	-	moisture (humidity)
N	-	pH
O	-	
P	-	pressure
Q	-	pressure drop
R	-	radioactivity (including neutron flux)
S	-	stress and strain
T	-	temperature
U	-	frequency or time
V	-	voltage
W	-	electrical power or energy (watts or watthours)
X	-	events or operations or electrical reactive power
Y	-	velocity
Z	-	vibration

INDEX FOR GROUP 5 - ELEMENT INDENTIFICATION
(for instrumentation only)

A	-	annunciator or alarm bell
B	-	discriminator
C	-	controller
D	-	detector (e.g. orifice or thermocouples)
F	-	fast trip
G	-	integrator
H	-	hand switch or controller
J	-	junction box
K	-	permissive or command contact
M	-	retransmitter
N	-	indicator
R	-	recorder
S	-	slow trip
T	-	transmitter
X	-	multiplier or auxiliary relay

V. Instrument Valves

AV - air supply valve
CV - control valve
DV - drain valve
EV - equalizing valve (DP cells)
HV - Hi pressure valve (DP cells)
LV - Lo pressure valve (DP cells)
SV - shut-off valve
VV - vent valve

Course 050

Lesson 050.002

NPD Systems - General

Indicating Lamp Codes

An indicating lamp colour code was adopted for NPD that is compatable with existing practice in the Commission, but is not the standard for H.E.P.C.

Indicating lamps are used to provide visual indication of the position or state of equipment or to indicate the condition of variables within systems.

At NPD the main theme of this code is based on four paired colours; red-green and amber-white.

Red-Green Pairs

A red lamp "on" indicates that the desired state does not exist.

A green lamp "on" indicates that the desired state does exist.

The desired state is one in which the station is delivering power to the system and safe conditions exist for both personnel and equipment.

Red-green pairs are used mainly in the Control Room annunciation system in conjunction with audible signals. There are a few red-green pairs used as position indicating lamps. These are only used in connection with the Dump Valves and Electrical Output System.

Amber-White Pairs

Amber - white pairs are used to denote "go" or "no go" situations.

An amber light "on" denotes a "no go" situation.

A white light "on" denotes a "go" situation.

The most common uses of amber - white pairs are as follows:-

Function	Amber On	White On
Valve or Damper	Closed	Open
Doors	Closed	Open
Switches, Breakers, etc.	Open	Closed
Rheostat	Lower Limit	Upper Limit
Unit (Motors, etc.)	Stopped	Operating

Groups of Lamps

Often there is much duplication of data, such as occurs in the individual Channel Flow and Temperature Monitoring Systems, the Multiple Systems temperature monitoring, and in the Leak Detection Systems. Since a high or low flow, high temperature or the existence of a leak is an undesirable situation, red indicating lamps are used. These lamps are usually grouped to-gether to form a rather compact display.

In the case of the Reactor channels flow and temperature monitoring display in the Control Room, the lamps are grouped to-gether in a single display which is a facsimile of the Reactor lattice arrangement. There is a clear plastic lens for each Reactor lattice position with two red indicating lamps situated inside each. The left-hand lamp is associated with flow monitoring and the right-hand lamp with temperature monitoring.

There is usally an annunciator associated with each of these groups. The annunciator directs the operator to the group of lamps and the individual lamps then provide the specific identity.

The Reactor channels temperature monitoring maintenance equipment in the Relay Room includes a display of white lamps in the form of a facsimile of the Reactor lattice arrangement. A white light "on" indicates that the particular channel temperature is being monitored at that moment.

The Reactor channels temperature monitoring alarm amplifiers, located in the Relay Room, are also arranged in a facsimile of the Reactor lattice. Each amplifier has a red lamp which is "on" when the unit is in the alarm state.

Single Lamps

In some cases information is given by a single lamp, which may be "on", "off" or "flashing".

Single lamps may be found in a variety of colours because many of these lamps are supplied as part of package units from different manufacturers.

Some of these lamps are "on" while others are "off" when the desired conditions exist, e.g. the white lamps monitoring flow switch positions in the IJW System are "on" when the switches are not tripped (normal), while the red lamps that indicate a power cut-back exists on the Regulating System are normally "off".

Certain lamps associated with the Temperature Monitoring data logger flash "on" and "off" when an abnormal condition exists.

On Control Room console #3 there are white lights which are associated with the various annunciator groups. These lamps are "off" when no alarm is actuated in the associated group, "on" when an alarm is actuated and "flashing" when an alarm is first actuated or cleared but has not yet been acknowledged.

Many single lamps are used to monitor power supplies or control circuits. Normally these lamps are "on" when the device or circuit is energized.

Red - Amber Pairs

At NPD this colour combination is used with some radiation instruments. The red lamp serving the same purpose as most red lamps do; to warn of an undesirable or unsafe condition, in this case high radiation fields. The amber light is also used to warn of an undesirable situation, but one which has a lesser degree of hazard attached. The amber light "on" indicates an instrument failure. This colour combination is used with the Portable and Fixed Gamma Radiation Monitors.

The Fixed Gamma Radiation Monitors have some additional features: A small current is passed through the red lamps continuously and should one of these lamps burn out (open circuit) an alarm is actuated to draw the operators attention. The visual result of this is that the red lamps (which are actually lighted push-buttons) glow dimly unless the alarm set point is exceeded, in which case they will glow brightly. Another feature is that these units have two radiation alarm set points. Normally, actuation of the lower alarm brings on the red lamp and actuation of the higher alarm brings on a pinkish coloured neon lamp.

Fuelling Machines

As in other coding, the F/M's have a scheme different from that found elsewhere in the station.

The one similarity in the system is that red lamps are used to indicate an undesirable condition and there is connection into the Control Room Annunciation System.

Following is a summary of the indicating lamps used with the F/M's.

Red - indicates an undesirable condition. On the Control Room panels, a red light signifies that the machine has tripped. On the Maintenance panels a red light "on" indicates a potentially unsafe operating condition.

Green - indicates that operating conditions are safe - permissives satisfied.

Amber - these lamps are used to indicate motion or movement of the various F/M components.

White - white lights are used to indicate position of F/M's and component parts or steps in the automatic programmes.

Yellow - "on" to indicate which location or magazine position has been ordered. "off" if no order selected or if the machine has reached the ordered position.

Many of the indicating lamps on the F/M's panels have the associated code etched on the lens of the lamp. On some of the amber motion lights the code is simply an arrow indicating the direction of travel. On some of the white position lights, where there may be numerous positions possible, the code takes the form of a number or number and letter index.

General

From time to time test equipment may be installed in NPD. Such equipment may come pre-assembled or be made up from existing spare parts. Indicating lamps used with such equipment are apt to be of different colours than those which are permanently installed.

Many indicating lamps also serve a dual purpose. Most indicating lamps receive their power supply from control circuits. If the power is off to the control circuit all of the associated lamps will be "off". The result of this is that, in addition to signifying the position or state of equipment, etc., the lights also indicate whether the control circuit or other power supply is energized or de-energized.

Where pairs of lamps are used for two position indication, limit switches are often employed to actuate the lamp circuits. Changing the function of these switches can change the lamp display mode during the period of movement from one position to the other, i.e., the lamps can be both "off" or both "on".

At NPD lamps are "off" during the period of movement. This is because the limit switches are usually closed when travel has been completed thus causing the appropriate lamp to be "on". However, at Douglas Point G.S. the other approach is used. When the device reaches the end of its travel a limit switch is opened which causes the opposite lamp to be extinguished. The advantage of this is; should the power supply fail during the period of motion (which is when it is most likely to fail) the operator will have immediate indication of this since both lamps will go out simultaneously. Better monitoring is also provided in the case of a burned out lamp. In the first instance, should the indicating lamp not come "on" within the expected time, the operator cannot tell immediately whether the lamp has burned out, the power supply failed or if the device has stuck part way in its travel.

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Course 050
Lesson 050.003

NPD Systems - General

Sundry Colour Codes

Many and varied are the colour codes already in use at NPD, in other Commission establishments and throughout industry in general.

This lesson is an attempt to summarize those codes used at NPD, so that the new employee can quickly become familiar with their use.

An examination of the visible light spectrum will show that the longest waves produce red light, the next longest produce orange light and the next yellow. These three colours are in widespread use throughout the world to attract the attention of people. In many cases these colours are used to signify danger, potential danger or relative importance. Where there are degrees of importance or significance, red is usually assigned to the highest degree, orange to the next highest with yellow following.

In their application within Ontario Hydro and specifically at NPD, colour codes may be divided into two categories; administrative and operational.

Administrative colour codes are used mainly to simplify routing and filing, whereas operational colour codes are normally used to identify areas or items of relative importance.

Administrative

Volumes in a book series having bindings of identical colours as follows:

Operating Manuals	-	Red
Design Manuals	-	Black
Commissioning Manuals	-	Dark Blue
Maintenance Manuals	-	Blue
Technical Training	-	Grey
In-Service Reports	-	Blue-Grey
Final Cost Reports	-	Brown

Where copies of forms etc. are sent to various people, departments or files these copies are often colour coded.

The Data Clerk sends out Routine Call-up Cards to remind departments that certain work functions need to be performed. The colour coding is as follows:

Control Maintenance	-	Green
Mechanical Maintenance	-	Blue
Operations	-	Buff
All Others	-	White

If the card is not returned to the Data Clerk within the specified time a pink follow-up card is sent out.

Deficiency Reports are used to initiate work where and when repairs, changes, etc., are required. The normal D.R. is printed with black lettering and is used in all situations not directly concerned with heavy water. These forms are also used for Change Approvals, which involve the installation of new equipment or changes in existing systems, etc. The heavy water D.R.'s are printed with green ink and are used when reporting deficiencies directly involving heavy water, such as leaks. Anyone may initiate a D.R. The originator sends the white and yellow copies to the Work Unit and the pink copy to the Control Room. When the work is completed the work unit will file the white and return the yellow to the Control Room where the pink copy is attached. The D.R. is then routed to interested parties and the yellow copy is finally filed by the Data Clerk. The pink is destroyed.

Work Authorizations are used to give the Shift Supervisors approval to maintenance units to proceed with work. The white copy is retained in the Control Room for filing while the blue copy is given to the man in charge of the work.

Work Authorizations may be accompanied by one or more of several types of tag or form. All of the "Do Not Operate" tags and Protection Guarantees (which are listed in the Standard Protection Code and will not be covered in this lesson) may be used in conjunction with Work Authorizations.

Radiation Hazard Permits and/or Special Hazard Permits are issued with, and become part of, Work Authorizations wherever unusual radiological or other hazards to the Workman may exist. The white copy of these forms is attached to the white copy of the Work Authorization while the pink copy is attached to the blue copy of the W.A.

NPD Heavy Water Transfer Forms are used to record movement of quantities of heavy water between Stores and Operations. The distribution of the coloured copies is as follows:

White	-	Recipient
Canary	-	NPD Data Clerk
Pink	-	Issuer

Heavy Water Internal Transfer - Additions is a white pre-printed form used whenever heavy water is added to systems or ion exchange columns are deuterized.

Heavy Water Internal Transfer - Withdrawals is a yellow pre-printed form used whenever heavy water is removed from a system an ion exchange column is de-deuterized, heavy water is transferred from drum to drum or heavy water is collected from vapour recovery mechanisms.

Request for Chemical Analysis or Investigation forms are used to request that such work be performed by laboratory personnel and also to record and report results of such work.

The white and yellow copies are sent to the Lab., usually accompanied by a sample of the material to be analysed. The pink copy is kept in the Control Room as a temporary file. Upon completion the Lab retains the white copy for file and returns the yellow to the Control Room, where it is filed and the pink copy destroyed.

NPD G.S. Shift Change Notice this form is used to notify all interested personnel of changes in an employee's work schedule. The distribution is as follows:

White	-	Control Room
Yellow	-	Shift Office
Goldenrod	-	NTC
Green	-	Security Guard
Blue	-	Accounts Clerk
Pink	-	Lunch Room (Bulletin Board)

NPD G.S. Operating Memos are used to initiate new work programmes, procedures, techniques, etc. These may be of a short term or long term nature. The routing of the two copies white and blue, is as follows: After preparation by the originator both copies are signed by the Assistant Superintendent, this being formal approval. The blue copy goes to the Superintendent and then to file. The white copy goes to the Control Room where it is kept on file until completion. Upon completion the white copy is returned to the originator. The white copy may also be returned to originator for review on a specified date.

Fuel Change Orders are initiated by the Fuel Engineer whenever it is required to insert and/or remove fuel from the Reactor. There are two copies, white and yellow; both are returned to the Fuel Engineer after completion.

Fuel Transfer Records are used whenever it becomes necessary to move discharged fuel bundles. Such movement may be between storage baskets or basket positions, or, to or from the Inspection Bay or into a shipping flask. These forms are prepared by the Fuel Engineer who retains the pink copy. The white and yellow copies are returned to the Fuel Engineer after completion.

Enriched Fuel Transfer Records are used each and every time an enriched fuel bundle is moved whether it is new, being installed, moved within a fuel channel, being removed, moved within the confines of the storage bay or being prepared for shipment. Fuel Change Orders are also made out for these bundles when they are being installed or removed from a fuel channel. The original of the Enriched Fuel Transfer Record is green with blue and pink carbon copies. The form is initiated from the Fuel Engineer's Office where the pink copy is retained. When the transfer is complete both the green and blue copies are returned to the Fuel Engineer. Enriched Fuel Transfer Records must be authorized by both the Fuel Engineer and Shift Supervisor.

Inter-Office Memos Sets are used extensively to pass messages. The originator writes the message, retains the pink carbon copy and forwards the white original and yellow carbon copies. The recipient may write a reply on the same form, retaining the white original and returning the yellow copy.

Load and Energy Sheets are used to record production and consumption of electrical energy. The white original is sent to Head Office, the canary coloured copy is retained in NPD files, (Technical Office) and the pink is kept in Control Room files for seven days.

Suggestion Plan used to formalize and process suggestions, made by employees, which may be useful to the Commission. Distribution is as follows: White original and yellow copy 2, to Suggestion Plan Co-ordinator. Yellow copy 3 to Suggestors Supervisor. Pink copy 4 to Suggestor.

Nuclear Training Centre Work Request used to request action by N.T.C. Distribution as follows:

White	-	NTC File
Yellow	-	NTC (Retain)
Goldenrod	-	NTC (Return on completion)
Green	-	NTC (Acknowledge and return)
Pink	-	Originator (Retain)

Work Request to C.N.O. used to request work, action, etc by C.N.O. Distribution is as follows:

White	-	Station File
Yellow	-	C.N.O. (Retain)
Goldenrod	-	C.N.O. (Acknowledge and return)
Green	-	C.N.O. (Return on completion)
Pink	-	Nuclear Operations Engineer.

Work Request to A.E.C.L. used to request work, action, etc. by A.E.C.L. Distribution is as follows:

White	-	File
Yellow	-	AECL (Retain)
Goldenrod	-	AECL (Acknowledge and return)
Pink	-	Nuclear Operations Engineer
Green	-	As Required
Green	-	As Required

Experience Memo to Pickering Operations. Distribution is as follows:

Copy 1 - White	-	Originator
Copy 2 - Yellow	-	Pickering "Active File"
Copy 3 - Goldenrod	-	Pickering Assignee (Retain)
Copy 4 - Green	-	Designer (Retain)
Copy 5 - Blue	-	Nuclear Operations Engineer
Copy 6 - White	-	Originator (On completion)
Copy 7 - Pink	-	Pickering Operations File

NPD G.S. Change Approval Request - Internal Form is used to ask for estimates, review by interested parties and approval of the Superintendent, for any proposed change to station systems, equipment, operating policy, etc. Distribution is as follows:

White	-	File
Yellow	-	Estimator
Blue	-	Reviewer
Pink	-	Nuclear Operations Engineer

If approval is obtained then NPD G.S. Proposed Change - External Form is prepared. Distribution is as follows:

White	-	File
Yellow	-	A.E.C.L.
Buff	-	Health Physicist
Pink	-	A.E.C.B.
Blue	-	C.G.E.
Blue	-	Douglas Point Operations
Green	-	As Required
Green	-	As Required

Correspondence may be typed in triplicate, the original copy being white, the temporary file copy being green and the official file copy being pink.

Ontario Hydro Fire Reports are pre-printed with red ink on white paper.

Automatic Operations Report forms are to be completed using a red pencil. Copies can be made by using red carbon paper.

Notification of Unplanned Doses form is used to initiate an investigation into the causes of an unplanned over exposure of personnel to radiation. Distribution is as follows;

White	-	Asst. Supt. - Supt.
Canary	-	Supervisor concerned - Asst. Supt.
Green	-	Health Physicist
Pink	-	Radiation Control Supervisor
Blue	-	Data Clerk File

Radiation Inspection Memorandum may be sent out by the Radiation Control Supervisor when an undesirable situation, etc. arises with respect to radiological conditions, records, reports, regulations, procedures, instruments or equipment. Distribution is as follows:

White copy to addressee, back to originator and then to file. Yellow copy to addressee, to Health Physicist, to Asst. Supt., to Supt., to file in General Office. Pink copy is retained by the originator (Radiation Control Supervisor).

Disposal of Active Waste - AECL 183 is used whenever radioactive waste material is shipped to AECL (CRNL) for disposal. The white and yellow copies are sent with the shipment to CRNL and the pink copy is retained for NPD files.

Injury to Personnel. The Commission requires that a Report of Accident and Investigation form be completed for all accidents irregardless of whether such accident involves injury to personnel. This form has several colour coded copies.

Where an accident involves injury to personnel requiring medical aid, there are numerous Workmen's Compensation Board forms that must be filed. Many of these forms are colour coded.

Operational

As was mentioned earlier in this lesson, no attempt will be made to outline the application of "Do Not Operate" tags and "Protection Guarantees" since these are covered in the Standard Protection Code. There are however, small plastic

tags used in the Control Room in conjunction with "Do Not Operate" tags and "Protection Guarantees". These tags are hung on controllers, etc. to indicate that some form of restriction or protection is in effect on the associated system or equipment. These tags are coded with the same colours as used for the "Do Not Operate" tags and "Protection Guarantees".

When new ion exchange columns are received on the station they are normally filled with light water to keep the resins from cracking. Light green tags with red lettering, stating that the columns contain H_2O, are attached to warn personnel that a column must not be connected into a heavy water system until it has been deuterized.

When ion exchange columns have been deuterized, pink tags with red lettering, stating that the columns contain D_2O are attached.

Where potential hazards to personnel exist that are of a more or less permanent nature, black and yellow diagonal stripes are employed as a visual warning. Some of the areas where such stripes are employed are; cranes and crane hooks, lift trucks, around some door openings, on tripping hazards, on sharp projections, etc.

Where potential hazards are of a temporary nature, red and orange "lollipop" signs are provided and are to be placed in a conspicuous position by the person or persons responsible for creating such hazard, i.e. when floor slabs are removed the people removing the slabs are also responsible for erecting the warning signs; (lollipops). Red "lollipops" denote a higher degree of hazard than do orange "lollipops".

All fire fighting equipment in the station is painted red or kept in red containers.

Red handled switches in the Control Room are associated with emergency services or systems.

Yellow and magenta are the "Radiological Colours", therefore, many of the lessons and procedures associated with radiological protection are printed on yellow paper.

Yellow and magenta ropes are provided to form barriers around areas or equipment that present a radiological hazard.

Adhesive tape with yellow and magenta diagonal stripes is provided and may be used as floor markings, etc., to warn personnel of an existing or possible radiological hazard.

Pre-printed signs, which are used extensively to inform personnel of radiological conditions, have magenta lettering on a yellow background.

Make-up signs are used to display information when pre-printed signs are not available. Two types are used at NPD; the boards with yellow background are to be used with magenta lettering to identify radiological conditions, while the boards with black background are to be used to identify non-radiological conditions or situations.

Adhesive labels, having a yellow background and magenta radiation symbol and magenta lettering stating, "Caution Radioactive Material" are used on containers, shielded flasks etc., that contain or may contain radioactive material.

Tags having a yellow background, magenta radiation symbol and magenta lettering are used to identify contaminated material. Red tags that may appear on contaminated equipment from time to time originate with AECL.

Class D Poison labels for use with shipment of radioactive materials are usually diamond shaped but come with a variety of symbols and colours. Those currently in use at NPD have white backgrounds, with red lettering for Group I and II Class D Poisons and blue lettering for Group III Class D Poisons.

Blackboard signs that are used to indicate location and intensity of radiation fields have a yellow border and magenta lettering in addition to the blackboard information area.

Shielded containers for radioactive materials are usually painted yellow in addition to having radiation symbols and labels on them.

Waste disposal containers in Zones 3 and 4 of the station are painted yellow since they may contain some low level radioactive materials.

"Rubber Boxes" and other containers designed to hold radiological clothing and/or equipment are painted yellow whether these containers are used for storage within the Station or are used for shipment to and from CRNL.

Yellow banded steel drums are used to ship radioactive waste to CRNL for disposal. If the γ radiation level on contact with a drum exceeds 200 mrem/hr a red top is placed on the drum instead of the normal black top.

Complete clothing changes are usually supplied to occupational workers in nuclear industries. At NPD outer clothing supplied is white, underclothing yellow and footwear is yellow and black. Additional wearing apparel which may be supplied for use in specific locations or situations may

or may not be of a distinctive colour. Some tests have also been carried out with coloured outer clothing.

Rubbers, for wear over normal footwear are supplied as a means of controlling the spread of contamination. Orange rubbers are used as the first line of defence. If severe contamination exists a "Rubber Change Area" may be set up. This is essentially a "rubber area" within a "rubber area". Red rubbers are supplied at the second "rubber station" and are for wear while inside the innermost area.

For persons normally working in Zones 2, 3 and 4 of the Station, yellow safety hats are supplied. For visitors and persons working in Zone 1, orange safety hats are provided.

Doors within and leading into the various "zones" of NPD are painted a particular colour for each of the four zones. Zone one - green. Zone two - yellow. Zone 3 - tan. Zone 4 - orange.

Not every form, etc., used at NPD has been listed in this lesson and new forms may come into use from time to time.

R. Whitney

Course 050

Lesson 050.004

NPD Systems - General

Piping Code

The Canadian Standards Association's Code for Identification of Piping Systems, B-53, 1958, was adopted for use in NPD. This code classifies materials according to whether they are dangerous, safe, protective or for fire protection.

To facilitate operation, maintenance and training an auxiliary identification scheme was adopted. This scheme is the painting of pipes or, insulation covering pipes, with different colours to identify the fluids within the piping.

This auxiliary identification scheme goes beyond the requirements of the C.S.A. code but does not change the basic intent of the code. Colour coding of piping is not necessarily peculiar to NPD. Present and future stations can apply the same colour coding if their requirements warrant it. Similar or identical piping colour codes are currently in use in some Ontario Hydro stations and within other organizations as well.

The auxiliary identification scheme employs the use of eleven colours. (Interim Proposal - NPDO-2). However, two of these, grey for organics and purple for vacuum systems, are not used in NPD.

The reasons for choosing the various colours are as follows:-

Red - this colour was chosen for fire protection because of its already widespread use for this purpose.

Aluminum - was chosen for steam lines because it is in general use in this application, mainly for functional reasons.

Brown - assigned to gas systems other than air, mainly to avoid dangerous confusion.

Pink - chosen for heavy water lines to clearly distinguish D_2O systems from H_2O systems, because of the cost of D_2O and the consequences of downgrading.

Black - chosen for drainage systems because drainage piping is usually supplied with a black protective coating.

At the time of construction of NPD the HEPC Standards Committee had assigned certain colours to identify specific systems in HEPC installations. These colours were incorporated as part of the auxiliary identification scheme.

Green - light water systems.

Tan - oil systems.

White - building heating water.

Blue - compressed air systems.

The desirability of painting the piping throughout its entire length is based on the following considerations:

1. Many materials in piping may be radioactive. The result being that not only is the material dangerous but, in many cases, the space for some distance around the piping is also dangerous from a radiation standpoint.

2. In the case of heavy water the material is very expensive and additionally will probably be radioactive.

3. Because of the high cost of heavy water, plant layout and piping system layouts are designed to minimize heavy water holdup. This results in a more congested arrangement of equipment than is generally found in other plants.

4. Piping is often grouped together and passed through thick shielding walls via a pipe chase which will have an offset to prevent radiation streaming. This arrangement makes identification of individual pipes very difficult.

5. Much of the piping is of small diameter, such as instrument tubing, which does not lend itself to identification with bands or labels.

6. Working time is often limited by radiation exposure in nuclear plants. Working time and radiation exposure can often be reduced if pipes can be easily distinguished from one another.

7. Piping, both lagged and bare, is usually painted for protection and/or appearance anyhow and additional cost arises only where painting of pipes is required for identification only.

8. The removal of radioactive contaminants from insulated piping is easier when the lagging is painted.

9. Painted piping is a distinct aid when training personnel.

Valve wheels and extension handle wheels are painted according to the colour of the pipe in which the valve is located. The reason for this being that the valve and piping cannot always be seen from where the handwheel is located. In some cases they are even located in separate rooms.

Whereas the auxiliary identification scheme requires the painting of the entire pipe the C.S.A. colour code uses labels of the appropriate background colour. These colours are used to identify materials within piping systems according to the following classification.

Yellow - dangerous material.

Green - safe material.

Blue - protective material.

Red - fire protection material.

According to the C.S.A. code these labels are to be placed wherever piping connects to equipment or passes through a wall or chase. The name or purpose of the system is to appear on the label in printed form. Where the outside diameter of the piping or covering is 1-1/2 inches or more 1 inch lettering should be used. If the outside diameter is less than 1-1/2 inches 1/2 inch lettering should be used. The labels should be oriented so that they are parallel to the long axis of the pipe. An arrow indicating the direction of flow is to be associated with each label.

In the application of the C.S.A. Code at NPD the very minimum number of labels required to identify and trace each pipe are attached. Also, the line number is included in the information on the label. In addition to this other pertinent information is included, such as the origin or destination of the pipe, whenever the end(s) of the pipe is not visible or not easily known.

Printing of information on the coloured labels is done with black felt markers.

The C.S.A. Code calls for red labels with white lettering for fire protection systems. Since, under the auxiliary identification scheme, all lines in these systems are painted red, white labels with black lettering were attached.

Feeder pipes in the Boiler Room are given special treatment.

Originally the feeders were all lagged and painted pink the same as other D_2O lines. Each feeder pipe was then identified by having the appropriate Reactor lattice position stencilled on the lagging. In addition to this the corresponding Reactor lattice positions were stencilled on the Labyrinth Seal adjacent to each bank or row of feeder pipes. The orientation of a lattice designation within its own row corresponds to the orientation of that particular feeder pipe within the bank or row of pipes. The letter I or O was added below each Reactor lattice designation to indicate whether the feeder is an inlet or outlet for that particular channel. See Fig. 1 attached.

Feeder pipe designations were stencilled on the Labyrinth Seal because it was recognized that these insulation covers might be removed and replaced, perhaps several times, over the years.

Following is a list of most NPD Systems according to their C.S.A. Classification.

1. Dangerous materials - yellow labels

   includes material which may be radioactive, flammable, poisonous, corrosive, at high temperature or high pressure.

   All heavy water systems.

   Helium.

   H_2O Reflector.

   Concrete Cooling.

   Spent Fuel Bay Water.

   All oil systems.

   Steam.

   Feedwater - if temperature may be above 100°F and pressure above 60 psig.

   Extraction Water.

   Chemical Feed.

   Chlorine - includes lines carrying chlorine/water mixture from the chlorinators.

   Process Drainage - those lines immediately downstream of heavy water heat exchangers or coolers.

Active Drainage.

Domestic hot water.

Building Heating hot water

Building Heating glycol

Process Air - those lines carrying air at main receiver pressure.

2. Safe materials - green labels

Feedwater - if temperature is below 100°F and pressure below 60 psig.

Process water.

Standby water.

Domestic cold water.

Make-up water.

Circulating water.

Circulating water air extraction.

Extraction air.

Process Drainage - except for lines immediately downstream of heavy water heat exchangers or coolers.

3. Protective materials - blue labels

Injection water - up to the light water side of IJW-BD1.

Dousing water.

Air mask or breathing air.

4. Fire Protection material - Red labels with white lettering. Since the fire protection systems at NPD are all painted red throughout, white labels with black lettering are used.

Fire fighting water.

Transformer Deluge.

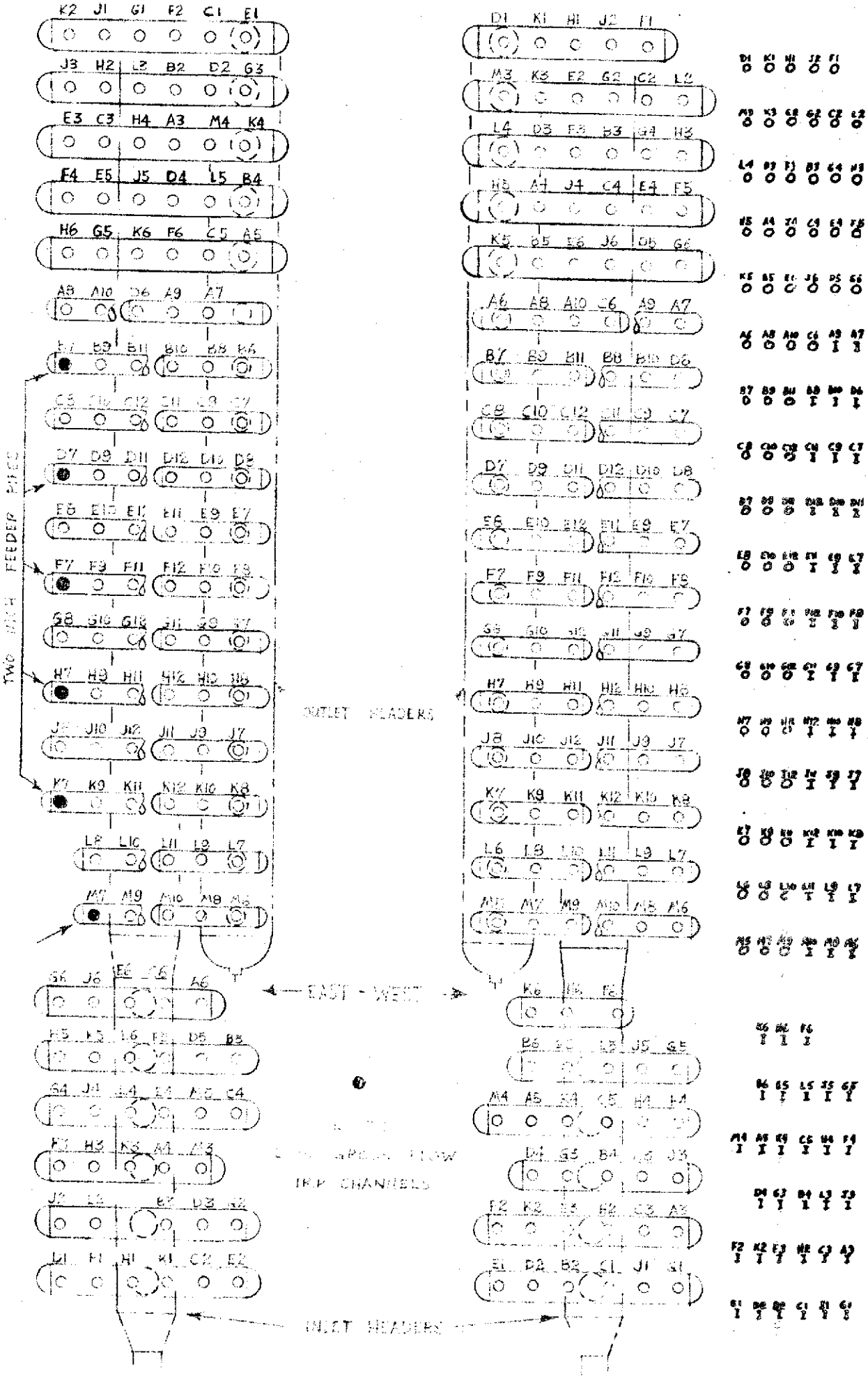
Generator CO_2.

It should be realized that there are other colour coding systems in the station and that similar colours may be used in these other codes. For this reason a list of the specifications for the colours used in the auxiliary identification scheme are included here.

Light Water	Waterfall Green	HEPC 3290
Heavy Water	Pink	CIL 86
Oil	Tan	HEPC 4020
Gas (other than air)	Brown	HEPC 4240
Air	Light Blue - CIL	Sailing Sky 153
Steam	Aluminum	
Building Heating Water	White	HEPC 4000
Drainage	Black	HEPC 4160
Fire Protection	Red	HEPC 4210

R. Whitney

FIG. 1


TWO INCH FEEDER PIPES
OUTLET HEADERS
EAST - WEST
INLET HEADERS

COURSE 050
LEVEL 4

NPD G.S. SYSTEMS

GENERAL

QUESTIONS

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1. Why are coded names used for equipment, etc., rather than the use of full names?
2. What is the correct coded name for Process Water Pump Number 1?.
3. What is the correct coded name for Moderator Temperature Number 1 Detector?
4. What is the full name of PDH-HX1?
5. What is the full name of PLO3H?
6. Why are indicating lamps used?
7. Where are red-green pairs of indicating lamps used at NPD? (In what capacity or function?)
8. Where are amber-white pairs of indicating lamps used at NPD? (In what capacity or function?)
9. Why are pipes and/or insulation covering pipes, painted over their entire length rather than just marked with identifying bands of colour?
10. What do the four colours, yellow, green, blue and red signify; as they pertain to the C.S.A. Piping Code?
11. What is meant by "dangerous materials"; according to the C.S.A. classification?
12. Why are many pre-printed form copies colour coded?
13. Why are doors colour coded at NPD?

14. What are the "Radiological Colours"?

15. What is the significance of red handled switches?

16. What colour are "Do Not Operate" Tags; Caution, Hold-off and Self-Protection?

17. What colour are "Protection Guarantee" tags; work and test permit, work permit and station guarantee?