

JOB INSTRUCTION NUMBER 34

SCALE MODEL CONSTRUCTION

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| 0 | 89.05.08 | ISSUED FOR PROJECT IMPLEMENTATION | gdh. | EB | EB |
| NO. | DATE | REVISION | BY | CHK | APPR. |
| | | HUSKY BI-PROVINCIAL UPGRADER CRUDE & SECONDARY UPGRADING PLANTS SCALE MODEL CONSTRUCTION | JOB INST. #34 CONT. C-4015 | | REV. |
| | | | BANTREL #237 | | 0 |

1.0 INTRODUCTION

The engineering model is a design tool used by engineers and designers to develop ideas and designs in a three-dimensional form. The model represents equipment, structures, piping, valves and fittings, instrumentation, lighting, and other features desirable for clarifying design. All engineering groups use the model to coordinate design information and develop the final design aided by the third dimension. When complete, the model is an accurate representation of the plant to be constructed. At the jobsite, the model is used by the construction forces and is also used by some clients as an operator training device.

Husky Bi-Provincial Upgrader will utilize a "design" model. Engineers and designers develop the design directly on the model, installing pipe in the design office. When the piping in an area is basically complete and approved by model review, the piping isometrics are drawn and checked, then issued for construction.

2.0 SAFETY PRACTICES

Design personnel are not normally authorized to operate model shop equipment. This will eliminate exposure to the more dangerous power tools. However, designers will be required to operate the design-room saw and sander.

There are inherent hazards to modeling, and the proper use of tools to work safely is mandatory. It is the individual's responsibility to develop safe working habits.

Safe operation of the design-room saw includes the use of push-sticks, backup sticks, blade adjustment, and safety glasses. Push-sticks permit the operator's fingers to remain at a safe distance from the saw blade as the material is being cut. Backup sticks give the operator more control of the material so it does not bind between the fence and the saw blade. Model work does not lend itself to the use of guards on the saw. Since preliminary small pieces are cut, a guard would in itself present a hazard.

It is absolutely necessary, for safety's sake, to adjust the blade to a height of no more than 1/8 of an inch above the material being cut. Safety glasses must be worn to prevent plastic chips and dust from entering the eyes.

Safety glasses must also be worn when operating the sander. Remember, sand on the down-side of the disc only. Although sanders have caused no major injuries, they can sand down the tip of the finger if caution is not used.

Hand tools such as knives, razor saws, dividers, height gauges, and scribes are dangerous to the extent that they are sharp or pointed instruments. Once again, as a reminder, it is the individual's responsibility to develop

safe working habits.

There are some inherent hazards of model building that should be taken into consideration. Most plastics when saw-cut have extremely sharp edges. The model base edges are "scraped" on all four sides, top and bottom, so as not to cut the bolt or tear a person's clothing. Pipe ends, platforms, edges of structures and the like can be a hazard to the eyes, face, or hands.

Proper housekeeping - keeping the model areas clean - is probably one of the best methods to assure safety on the job. A day-by-day cleanup is necessary to keep items in their proper place. Beware of tripping hazards such as extension cords or such slipping hazards as small pieces of tubing or pipe as well as dust left carelessly on the floor.

REMEMBER - SAFETY AT ALL TIMES!

3.0 SCOPE

- 3.1 This specification covers the general requirements for construction of a three dimensional plastic scaled model.
- 3.2 Areas to be modeled will be as identified in the project specification and will generally be the area within a process battery limit.

4.0 DEFINITIONS

Full scale piping system - the method of modelling by which the pipe is represented to a scale of 1:33 1/3.

5.0 MATERIALS

- 5.1 The model table frame shall be of wooden construction complete with tubular steel legs as per Attachment "A" of this specification.
- 5.2 The model table top shall be 5 mm thick white matte finish plexiglass fastened to 16 mm thick exterior grade plywood.
- 5.3 Model components shall be made of standard plastic model material.
- 5.4 Components such as motors and pumps should be standard EMA parts where available.
- 5.5 Marking pens for tagging shall be non-smearing and non-fading.
- 5.6 Standard model solvent shall be used for cementing components together.
- 5.7 Standard model labels shall be used.

6.0 DESIGN

A full scale system of piping will be used.

The minimum requirements for design shall include but not be limited to the following unless otherwise specified.

- 6.1 Model shall be built to a scale of 1:33 1/3 metric.
- 6.2 All co-ordinates and elevations shall be in SI units.
- 6.3 Maximum model table size shall be 915 mm wide x 1830 mm long. Towers or columns higher than 1000 mm from underside of base shall be fitted with a joint at the 1000 mm height.

Tolerances and Limitations

Model tables shall be built to a tolerance of ± 1.5 mm full size.

Model components and locations on base shall be built to a tolerance of ± 50 mm at the scale of 1:33 1/3 metric.

7.0 INSPECTION AND TESTING

The scale model will be subject to review at any time by Husky.

Formal review by design, operations, maintenance and safety groups from Husky will be scheduled.

8.0 HANDLING AND STORAGE

Models will be transferred to the construction site to assist the field staff and construction contractors.

Models shall be shipped in vans with air cushioned suspension. Each model shall sit on a cushioned pad and be secured at all four corners.

9.0 PHOTOGRAPHING OF MODELS

1. All photos shall be in colour
2. Progress photos shall be supplied every 20 working days and upon request.
3. All permanent photos shall be done in a professional manner, in colour on 216 mm x 280 mm (8½ - inch x 11-inch) stock.
4. All photographs shall have a photo number, base number, North arrow and date.
5. The Plant Layout and Piping Job Leader, together with the Project Engineer shall select the location of each photograph. They will also check through the view finder to ensure the camera is correctly positioned.

10.0 FABRICATION

10.1 The minimum requirements for fabrication shall include but not be limited to the following:

10.1.1 Piping

- All NPS-2 and larger shall be modelled.
- Valve handwheels shall be shown with actual orientation.
- Chain operated valves shall be shown with chain.
- Reducers shall be called up as eccentric or concentric.
- Insulation sleeves shall be shown.
- Pipe shoes shall be shown.

- Blinds shall be shown.
 - Open and closed drains shall be shown.
 - Fictitious supports may be used for model stability using clear plastic.
 - Steam and condensate manifolds for steam tracing shall be shown.
 - Utility Stations shall be shown.
- 10.1.2 Mechanical
- All davits shall be shown in actual orientation.
 - Platforms
 - Ladders and cages.
 - Pipe supports and guides.
- 10.1.3 Structural
- Main members of structures.
 - Platforms
 - Ladders and cages.
 - Fireproofing.
 - Buildings shall be built showing main structure members and all curbs but a minimum representation of wall and roof sheeting.
- 10.1.4 Civil
- Retention dikes
 - Outline of roads
 - Outline of railroads
 - Curbs
 - Area drains
 - Building roof drains
- 10.1.5 Instrumentation
- All on-line and in-line devices
 - All direct mounted level devices
 - All primary sensing prints for differential type level instruments, showing screwed or flanged connections
 - All post mounted instruments
 - All winterized enclosures
 - All DCS field enclosures
 - All analyzer houses and local panels
 - All instrument junction boxes
- 10.1.6 Electrical
- Light fixtures, welding receptacles
 - Power and instrumentation trays
 - Bridges
 - Transformers
 - Terminal boxes
 - Distribution panels
 - Control panels
 - Switchgear/MCCs
 - Control stations

- 10.1.7 Modules
- To Be Detachable

11.0 IDENTIFICATION

11.1 The following guide lines highlight the minimum requirements to identify model components clearly.

11.1.1. Piping

- Line numbers complete with size and piping specification
- Spec breaks
- Insulation
- Heat tracing
- Anchors and guides
- Suction strainers
- Fitting to fitting
- Specialty items
- Work points of sloped pipes
- Flow direction
- Contents of pipe, in racks and sleepers

11.1.2 Mechanical

- Design temperature and pressure
- Outside diameter of vessels, etc.
- Tan to tan length
- Nozzle orientation, size and rating
- Pipe supports and guides

11.1.3 Structural

- Pipe support numbers
- Building name and size
- Platform numbers

11.1.4 Instrumentation

- All instruments directly connected to piping systems or to equipment.
- All instruments in winterized enclosures
- All primary elements
- All instrument junction boxes

11.1.5 Electrical

- MCC's, switchgear
- Terminal boxes
- Control modules
- Sub Stations
- Distribution panels
- Transformers

11.1.6 Modules

- Tagged with module number

12.0 DOCUMENTATION

The minimum requirements for tagging information will include, but not be limited to the following:

12.1 Elevations

12.1.1 Piping

- Centre line of control valve
- Work points
- Bottom of pipe except where a top of steel is given.

12.1.2 Mechanical

- Centre line of horizontal vessels.
- Upper tan line of vertical vessels
- Centre line of horizontal shell/tube and pipe exchangers.
- Work points of sloped equipment.
- Center line or face of flange of nozzles.

12.1.3 Structural

- Top of steel for structures
- Top of steel for racks and sleepers
- Top of steel for stringers in racks
- Top of steel for pipe supports
- Top of platforms

12.1.4 Civil

- Crown of roads
- High point of paving
- Finished grade
- Curbs
- Top of dike
- Toe of dike

12.2 Co-ordinates

12.2.1 Piping

- One flange face of all inline flanged components unless it is a fitting to fitting application from a reference point.
- All changes in direction
- Each end of a pipe that runs through the model base.
- Branch connections.

12.2.2 Mechanical

- Centre lines of vessels, channel nozzles, shell/tube and pipe exchangers, nozzles on air exchangers, pumps, blowers compressors and turbines.
- Outer edge of package equipment.
- Tan line on horizontal vessels.

- 12.2.3 Structural
 - Edge of sleepers
 - Center lines of all supports
 - Center lines of all columns
- 12.2.4 Civil
 - Center lines of underground piping and sewers
 - Center lines of roads
 - Center lines of dikes
 - Toe of dikes
 - Centre line of railroads
 - Two outer edges of building foundation
- 12.2.5 General
 - Outer edges of model base
- 12.2.6 Instrumentation

Instrument sensing points such as pressure and temperature points will be represented by a dab of pink paint, use green for electrical sensors (Tag only on vessels, columns, furnaces etc., but not on piping).

13.0 TAGGING

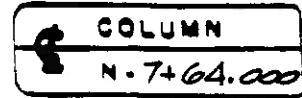
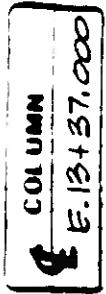
13.1 General

1. Group elevations, line numbers and coordinates when possible.
2. Table top shall have grid system scribed on and identified by coordinates.
3. Underground piping shall be shown using tape and identified as previously stated.
4. Pipe spacing scale shall be used at each end of pipe rack.
5. Each model base shall have a key plan, board number and north arrow.
6. The Plant design and piping group will be responsible for proper tagging to facilitate lifting information from the model for preparation of isometric drawings.
7. All necessary tagging will be applied immediately upon completion of equipment and pipe run installation on the model.
8. Model tags, when possible, will be placed to read from the same orientation as the plot plan. Tags will be lettered with drawing ink. No ball point or fountain pens to be used.

9. To assure the adhesion of model tags, the following procedures must be employed:
 - o Avoid excessive bending in removing tags from backing.
 - o Clean line of any dust, dirt, or oil before placing tag.
 - o Press tag firmly to pipe along full tag length, making sure to seal the edges.
 - o If it becomes necessary to change a line, make a new tag.
10. Model data books shall be attached to the model base prior to shipping.
11. Graphic scale shall be fixed to each table top.

13.2 PIPEWAY

- a) Both coordinates of each pipeway stanchion.
- b) Number and letter designation of each pipeway stanchion.
- c) Elevation of each pipeway level. (Top of steel or top of concrete elevation).
- d) Pipe spacing scale (one at each end of pipeway on each base).



13.3 BASE TAGS

- a) High point of paving
- b) Catch basin rim elevation



c) Road centerline

ROAD
E. 13+53.250

d) Plot area limit

PLOT LIMIT
N. 13+13.000

e) Edge of base

BASE EDGE
7+67.250

f) Trench centerlines

TRENCH
N. 13+57.775

g) Edge of curb

CURB EDGE
N. 13+50.250

h) Structure column
centerlines

E. 13+53.200

j) Equipment centerlines

2-C-1
N. 7+14.000

k) Horizontal drum tangent
line (Nearest to pipeway)

TANGENT LINE
N. 7+19.350

l) Pump discharge or face of foundation

DISCHARGE
E. 13+31.700

m) Exchanger channel nozzle centerline

CHANNEL NOZZ.
E. 13+42.525

n) Compressor cylinder centerline

CYLINDER
N. 7+98.000

p) Base number

BASE NO. 15

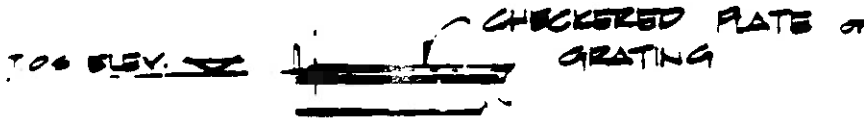
q) Base north arrow

r) Model base legend (one each plant)

13.4 STRUCTURES

a) Top of Steel or top of concrete elevation.

T.O.S. E. 107.250



b) Platform elevation
T.O.S = Top of supporting steel (underside of floor plate or grating)

PLATFORM NO. 2
T.O.S. E. 112.250

c) Equipment centerline where applicable

2-C-2
E. 13+53.250

13.5 COLUMNS

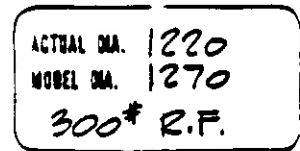
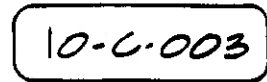
1. Nozzles and manways

- a) Identification
- b) Centerline elevation
- c) Size/orientation from north
- d) Nozzle projection from vessel centerline (manways excluded)



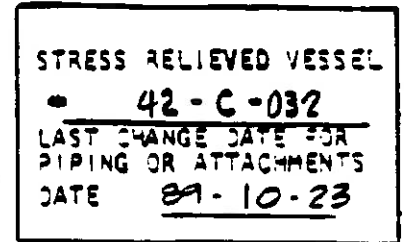
2. Master Tag

- a) Equipment number
- b) Actual vessel diameter
- c) Model vessel diameter
- d) Nozzle rating and facing



- e) Stress relieved vessel (coral colored tag)

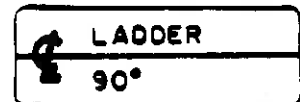
(year, month, date)



3. Platforms

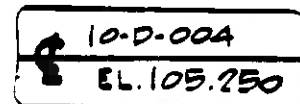
- a) Number and elevation
Refer to paragraph 13.4.b

- b) Ladder orientation



13.6 DRUMS

1. Centerline elevation



2. Platform elevation
refer to paragraph 13.4.b

3. Nozzles and manways

- a) Identification
- b) Distance from tangent line
- c) Size/orientation from vertical centerline
- d) Nozzle projection from drum centerline (manways excluded)

MI
2000
24/0°

NI
2750
10/180°
1830

4. Master Tag

- a) Vessel number designation
- b) Actual diameter
- c) Model diameter
- d) Nozzle rating and facing

10-D-004

ACTUAL DIA. 1850
MODEL DIA. 1900
300# R.F.

5. Slope

- a) Slope tag
- b) Work point elevation

SLOPE 300 PER. 75 000

W. P. ELEV.
112 700

13.7 EXCHANGERS

- 1. Centerline elevation

10-E-009
EL. 118 250

13.8 PUMPS, TURBINE DRIVERS AND COMPRESSORS

- 1. Centerline elevation of shaft

10-T-009
101 350

13.9 PIPING

- 1. Pipe

Each pipe in pipeway should be tagged; normally tagging one end of the pipeway is sufficient. Tagging should be sufficient for isometrics and checking.

- a) Direction of flow
- b) Line number
- c) Size
- d) Specification

10 P232 - 30 - AAKF

- 2. Pipeway spacing-distance from reference stanchion centerline.

4250

- 3. Coordinate where line enters or leaves pipeway.

N.7+63.250

4. Centerline elevations where they are not at normal pipeway elevations C.E. 106.250
5. Vertical lines at columns N. 3+53725
- a) Coordinates
- b) Orientation 30°
6. Coordinate of one leg of control manifolds N. 7+65440
7. Coordinate of underground lines and stub-ups E. 13+42500
8. Coordinate of vertical runs with the exception of predetermined vertical drops from pipeway E. 13+27450
9. Control valves 10PV
73

14.0 Colour Code

General

14.1 Insulation

- o No insulation to be indicated on equipment.
- o White insulation sleeve to show hot insulated lines.
- o Steam tracing insulation sleeve to be light blue.
- o Purple insulation sleeve to show cold insulation.
- o Electrical tracing insulation sleeve to be light green.
- o Personnel protection insulation shall be a white sleeve tag with PP attached.

| | |
|-------------------------------------|---------------------------|
| 14.2 Structural steel | Steel grey |
| Concrete | Concrete grey |
| Equipment | Vessel and equipment grey |
| Electrical | Electrical green |
| Instrumentation | Instrumentation pink |
| HVAC (ducts & equipment) | Light blue |
| Fictitious model supports | Transparent |
| Safety equipment | Red |

14.3 Grade or underground

| | |
|------------------------------|-----------------------|
| Building walls | Black tape |
| Underground piping | Black centerline tape |
| Roads | Brown tape |
| Plot limits | Black plot limit tape |

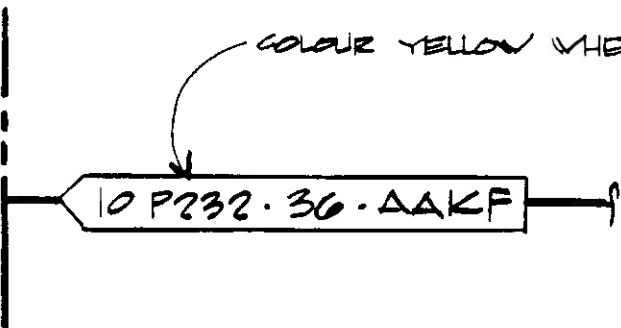
A colour code plaque shall be attached to each model.

PIPING COLOUR CODE

| | | | |
|---------------|--|-----------------|--|
| <u>ORANGE</u> | <u>PROCESS</u> | <u>GREEN</u> | <u>WATER</u> |
| | <ul style="list-style-type: none"> - Acid - Caustic - Catalyst - Hydrogen - Chemicals (Catacarb, etc.) - Nitrogen - Process Lines (Hydrocarbons, Ammonia etc.) - Relief & Blowdown - Process - Fuel Oil - Fuel Gas - Natural Gas - Purge Gas (purge, inert, etc.) | | <ul style="list-style-type: none"> - Boiler Feed Water - Cooling Water (Supply & Return) - Drinking Water - Fire water - Process water - Raw water - Treated water - Utility water |
| <u>YELLOW</u> | <u>STEAM</u> | <u>PINK</u> | <u>AIR</u> |
| | <ul style="list-style-type: none"> - Low Pressure Steam - Medium Pressure Steam - High Pressure Steam - Relief & Blowdown - Steam | <u>BLUE</u> | <ul style="list-style-type: none"> - Instrument Air - Process Air - Utility Air |
| | <u>CONDENSATE</u> | <u>RED</u> | - Alloy - exotic |
| | <ul style="list-style-type: none"> - Low Pressure Condensate - Medium Pressure Condensate - High Pressure Condensate | <u>EQ. GREY</u> | - Vendor piping |
| | | <u>WHITE</u> | - Fittings |

EDGE OF MODEL BASE

COLOUR YELLOW WHEN CHECKED



DESIGN AND CONSTRUCTION OF MODEL

15.1 MODEL TECHNIQUES

As in any other type of work, there are certain methods that will work more effectively than others. Some of the more important ones are listed for reference.

1. When bending pipe, make every effort to fabricate the entire spool from one continuous piece. If the piece must be cut in order to fit into the model, do so after bending.
2. Make absolutely sure that each bend is true and square before proceeding to additional bends in a continuous line.
3. Remake pipe where inaccurate. Do not try to salvage bent pipe. Do not piece together a number of short lengths.
4. Some subassemblies of piping, such as utility hose stations at grade, sample coolers manifolds, etc., can be made in quantity prior to model installation. This can aid speed and accuracy during installation.
5. Wherever a series of dimensions exists, as in a pipeway, add the dimensions so as to locate any one particular line from the base reference point; usually the centerline of a pipeway stanchion.
6. Locate pipe from structural columns and equipment centerlines; never from other pipe.
7. When installing pipe, mark the pipe where it crosses structural reference lines, and, in turn, mark the structural member where the pipe crosses it. This facilitates accurate assembly of pipe in the model.
8. Where no permanent support can be attached to the model structure or equipment, install a temporary one prior to installing the spool.
9. Install as many supports as possible prior to fitting the pipe on the model. This serves three major purposes: It checks the accuracy of your pipe fabrication; it eliminates the need of temporary supports; and it facilitates pipe installation.
10. Dummy pipe supports need not be placed to represent their actual location. They are fictitious only and are modeled in clear plastic.

11. Valve orientations are taken directly from the model. If a valve is not cemented correctly, it can be rotated accidentally out of position and a correspondingly incorrect installation can result in the field. Cementing valves will be the responsibility of the lead designer. Cementing will take place after the checker has checked the valves for their proper orientation.

15.2 EQUIPMENT

Components will preferably be fabricated from vendor prints; however, if timing is critical, sketches supplied by the Lead Designer may be used. Equipment is to be made in simple outline. Do not show unnecessary detail. Equipment in most cases will be installed on bases in the shop.

15.3 STRUCTURES

Structures will be fabricated and installed on model bases as design sketches covering column and primary beam sizes are issued by the Structural Group. Secondary structural members and major pipe supports will be installed only as required for design clarification and interference consideration. This must be determined in the design group as the model develops.

15.4 PIPING SYSTEMS

Process and utility piping will be installed complete on the model for all sizes in sufficient detail to enable an isometric detail drawing to be made. Piping material colors on the model will be as shown on page 17 of this specification.

Model tagging procedures will be per guidelines described in section 13.0 of this specification.

Piping items that do not require complete installation on the model are as follows:

15.4.1 Utility Stations at grade (All other locations, vessel platforms, etc., route and install).

- 1) Show takeoff points from headers only (do not route to station assembly at grade) and identify with line numbers.
- 2) Show a partial assembly at grade consisting of water, steam and air, identifying with line numbers and a utility station number.

Auxiliary piping for pumps and turbines

Show takeoff points from headers only (do not route to equipment). Identify with line numbers. It may be necessary to provide sub-headers to service groups of equipment. If so, they shall be shown on model.

Compressor Auxiliary Piping

2" and smaller piping will be detailed on drawings. Show takeoff connections at headers on model. (do not route to equipment) Identify with line number tags.

3" and larger piping will be shown on the model and isometric drawings.

Tracing (Steam and Electrical)

Steam tracing and electrical tracing shall be shown on the model as outlined on page 16 of this specification.

15.4.2 Housekeeping

Good housekeeping is essential to efficient model work. A day to day clean-up is necessary to keep items in their proper place. Too much time is lost looking for modeling tools temporarily misplaced due to improper housekeeping.

15.4.3 Parts

A fully stocked movable piping parts cabinet will be located in the model design area and restocked whenever supplies run low.

15.4.4 Tools

Each designer working on a model should have his own set of small hand tools, which will be returned to the Design Supervisor or Lead Designer as each man is assigned to another job. These tools should include a set of pliers, a shoe knife, a scribe, a marking pencil for plastics and a rapidograph pen. The other tools, used occasionally, can be community property and will be stored in a movable tool cabinet also located in the design area.






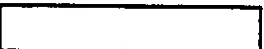
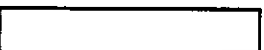
15.4.5 Smoking

Do not smoke in the modelling area.




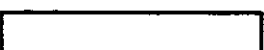
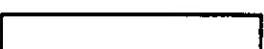
Avoid leaving coffee cups in model bases.

If by accident, the solvent should spill on the model base -DO NOT WIPE UP. wiping will damage the surface of the model base and additional work will be required to restore it to an acceptable appearance.

LEGEND

| | |
|---|--------------------------------|
|  | ALLOY PIPING |
|  | ELECTRICAL |
|  | INSTRUMENTATION |
|  | UNDERGROUND SEWERS, ETC. |
|  | ROADWAYS |
|  | STEEL, STRUCTURAL |
|  | CONCRETE, STRUCTURAL OR FOUND. |
| WHITE SLEEVE | INSULATION - HOT |
| PURPLE SLEEVE | INSULATION - COLD |
| LT. BLUE SLEEVE | INSULATION - STEAM TRACED |
| GREEN SLEEVE | INSULATION - ELECTRICAL TRACED |

PIPING COMMODITY LINE TAG

| | |
|---|------------------------|
|  | PROCESS |
|  | STEAM AND CONDENSATE |
|  | AIR |
|  | WATER |
|  | FUEL AND MISCELLANEOUS |

ATTACHMENT

TYPICAL MODEL BASE LEGEND

JOB No. _____

SCALE 1 = 33 1/3