Winnipeg Sewage Treatment Program
Integrated Management System

Functional Design Requirement

Project title: Sludge Truck Auto-Loading Automation System Replacement

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1 PURPOSE

The sludge cake storage system consists of 3 sludge storage bins, a system for weighing the sludge cake, equipment necessary for loading the sludge cake into hauling trucks, and a process logic controller for bin controlling and record keeping of the hauled sludge.

This document is an accompaniment to RFP 469-2015 in addition to 469-2015 Part E – Technical Specifications and details further the Functional Design Requirement of the system to be installed.

2 DEFINITIONS

The following list details the definitions in this document

(a) **"ABB"** means the manufacturer ASEA Brown Boveri.

(b) **"CPU"** means Central Processing Unit associated to the PLC.

(c) **"CSA"** means the Canadian standards association international, formerly the Canadian standards association.

(d) **"DCS"** means distributed control system, an existing ASEA Brown Boveri INFI90 control system to be replaced as part of the upgrades.

(e) **"HMI"** means human machine interface, a subsystem of the PCS that provides the operator user interface for the entire water pollution control centre.

(f) **"intelligent"** means an automation component or system that communicates with the site control system and operates via instructions given and received over a communication medium of a protocol such as Ethernet, PROFIBUS, MODBUS or HART.

(g) **"I/O"** means input/output.

(h) **"LHMI"** means local human machine interface, a HMI local to the equipment such as a Schneider Electric Canada Inc. Magelis touchscreen.

(i) **"MCC"** means motor control centre.

(j) "**NEWPCC**" means the City of Winnipeg North End Sewage Water Pollution Control Centre located at address 2230 Main Street, Winnipeg, Manitoba, R2V 4T8.

(k) **"PCS"** means process control system. The control system of the water pollution control centre that provides monitoring and control of the wastewater treatment process and ancillary systems, including HVAC and building services.

(l) **"PLC"** means programmable logic controller, a component of the PCS that performs monitoring and control of processes within the water pollution control centre.

(m) **"SD"** means Secure Digital relating to SD Cards.

(n) **"SEC"** means Schneider Electric Canada Inc.

(o) **"WWD"** means City of Winnipeg Water and Waste Department.

3 UNITS OF MEASURE

All drawings and documentation, including design calculations, and field instruments shall use the International System of Units (SI units). Imperial units on drawings and documentation will be provided in parenthesis after the metric unit, where requested or appropriate.

4 ASSOCIATED DOCUMENTS

The following tables list the drawings associated with this Functional Design Requirements.

Drawing Number	Rev.	Description	Type
1-0101W-A0321	03	Sludge Cake Storage Fill Valves	P&ID
1-0101W-A0322	03	Sludge Cake Storage Bins	P&ID
1-0101W-A0323	03	Sludge Cake Storage Bin #1 Loadout	P&ID
1-0101W-A0324	03	Sludge Cake Storage Bin #2 Loadout	P&ID
1-0101W-A0325	03	Sludge Cake Storage Bin #3 Loadout	P&ID
1-0101W-A0326	03	Sludge Cake Loadout Overhead Doors	P&ID
NEP 1836	02	Weigh Out and Septage System panel interconnection (#1 West)	Wiring Diagram
NEP 1855	02	Weigh Out and Septage System panel interconnection (#1 West)	Wiring Diagram
NEP 1856	02	Weigh Out and Septage System panel interconnection	Wiring Diagram
NEP 1857	02	Weigh Out and Septage System panel interconnection	Wiring Diagram
NEP 1858	02	Weigh Out and Septage System panel interconnection	Wiring Diagram
NEP 1888A	00	Weigh Out and Septage System panel interconnection #1 West - Auger	Wiring Diagram
NEP 1885	00	Weigh Out and Septage System panel interconnection #1 West	Wiring Diagram
NEP 1887	00	Weigh Out and Septage System panel interconnection #1 West	Wiring Diagram
NEP 1888	00	Weigh Out and Septage System panel interconnection #1 East	Wiring Diagram
NEP 1889	00	Weigh Out and Septage System panel interconnection #2 West	Wiring Diagram
NEP 1890	00	Weigh Out and Septage System panel interconnection #2 West	Wiring Diagram

NEP 1891	00	Weigh Out and Septage System panel interconnection #2 West	Wiring Diagram
NEP 1892	00	Weigh Out and Septage System panel interconnection #2 East	Wiring Diagram
NEP 1893	00	Weigh Out and Septage System panel interconnection #2 East	Wiring Diagram
NEP 1894	00	Weigh Out and Septage System panel interconnection #2 East	Wiring Diagram
NEP 1895	00	Weigh Out and Septage System panel interconnection #3 West	Wiring Diagram
NEP 1896	00	Weigh Out and Septage System panel interconnection #3 West	Wiring Diagram
NEP 1897	00	Weigh Out and Septage System panel interconnection #3 West	Wiring Diagram
NEP 1898	00	Weigh Out and Septage System panel interconnection #3 East	Wiring Diagram
NEP 1899	00	Weigh Out and Septage System panel interconnection #3 East	Wiring Diagram
NEP 1900	00	Weigh Out and Septage System panel interconnection #3 East	Wiring Diagram
NEP 1901	00	Weigh Out and Septage System panel interconnection - Miscellaneous	Wiring Diagram
NEP 1904	00	Weigh Out System Emergency Stop Button Layout	Wiring Diagram
NEP 1905	00	Sludge Dewatering Building Weigh Out and Septage Panel Power Distribution	Wiring Diagram

Table 4.1

5 GENERAL DESCRIPTION OF THE SYSTEM

Dewatered sludge cake from each centrifuge is pumped to one of two manifolds feeding the sludge storage bins. Sludge cake pumps 1, 3, and 5 pump sludge cake to the east side of sludge bins No. 1, 2, and 3 via one manifold. While sludge cake pumps 2, 4, and 6 pump sludge to the west side of the bins via the other manifold. At each end of the sludge cake pipe discharge into the bins is an automated pneumatic control valve.

Each sludge cake bin is mounted on a scale located at each bin support point. Each scale has a load cell mounted in a saddle. The bin weight is transfer through the load cell to an active weighing platform which is suspended by two links.

The load cell is an electrical resistance element connected to a Wheatstone bridge. The system is calibrated to match the resistance with the corresponding weight.

Each bin is divided into an east side and west side by two hopper bottoms. Each hopper bottom has a live bottom feeder with two screw augers. The motors are at opposite ends to each other and move the material towards the motor end. Four air operated knife gate valves are mounted on each live bottom feeder. Two valves serve one auger and the other two serve the second auger. At each valve is a bell bottom chute, which guides sludge into the sludge truck through the openings in the truck lid. Convex mirrors mounted between the chutes refers the position of the chutes at the openings in the truck lid.

Access by trucks to the storage bins will be gained through one of two truck bay doors on the north side of the truck bay area. Two red/green stop lights are mounted on the exterior of the building to control the entrance of trucks. Six similar lights are located in the interior of the bay area to position trucks under one of the storage bins. A further set of overhead doors on the south side of the building allows vehicles to exit the area. These doors also have two stop lights mounted nearby to control truck egress.

The following equipment makes up the sludge cake storage, weighing, and load out system:

a) Three Sludge Cake Storage Bins – 200 m^3 capacity;
b) Six Pneumatic Outlet Valves – W410-HV to W460-HV;
c) Twelve Screw Augers – W412-SCA to W462-SCA & W417-SCA to W467-SCA;
d) Twenty Four Discharge Valves:
    i) W413-HV to W416-HV;
    ii) W423-HV to W426-HV;
    ii) W433-HV to W436-HV;
    iii) W443-HV to W446-HV;
    iv) W453-HV to W456-HV;
    v) W463-HV to W466-HV.

e) Four Overhead Doors – W510-TD, W511-TD, W520-TD, W521-TD.

A schematic of the process is shown in Figure W700 while elevations are shown in Figures W701, W702, and W703. Locations of this equipment can be seen in Figure W704 to W707.

6 CONTROL REQUIREMENTS

6.1 GENERAL REQUIREMENTS

The monitoring and control of this system will be provided through a Programmable Logic Controller (PLC) housed in the existing Bin Weight-Out Control Panel of the manufacturer Schneider Electric Canada Inc. (SEC).

The models of PLC available to accomplish the monitoring and control task can be of the following three of;

a) Quantum;
b) M580
c) M340
d) Utilizing in-rack I/O, or, remote X80 I/O.

The models of LHMI available to accomplish the operator and truck driver interface with the control system should be either of SEC;

e) Magelis GTU;
f) Magelis GTO.

The ABB DCS InfiNet 90 only acts in a supervisory and manual intervention capacity of the following instructions:

g) Open/close position of outlet valves;
h) Bin weight;
i) Bin level;

j) Open/close position of discharge knife gate valves;

k) Motor run status of augers;

l) Bin Weigh-Out Controller failure.

The SEC PLC control system should be able to operate independently of the DCS in automatic mode

6.2 CONTROL SYSTEM AND LHMI LAYOUT REQUIREMENTS

Where possible, the new installation should seek to use existing panels, junction boxes and wiring termination rails as far as practicable.

The new SEC PLC arrangement should occupy the original Datum PLC space within the Bin Weighout panel. For ease of installation and Factory Acceptance Testing (FAT), the new SEC PLC arrangement may be constructed on a new back-plate and at the time of installation, the new back-plate complete with SEC PLC installed on top of the existing Datum PLC back-plate within the Bin Weighout panel.

The new operator specific LHMI in the local control room should be panel mounted onto the front of the existing Bin Weighout panel. The second truck driver specific LHMI should be panel mounted in the same location as the existing truck driver specific control LHMI and printout room in the truck bay area.

Further details related to the appropriate spacing of SEC PLC CPU's, power supplies and I/O can be found in the WWD Automation Design Guide.

6.3 SYSTEM REDUNDANCY REQUIREMENTS

The control system is required to be fully redundant so that in the rare event of a failure of a SEC PLC component or LHMI, that the entire sludge truck loading facility is not taken out of commission and is able to continue to operate between 66% and 100% of normal capacity in fully automatic mode. The Systems Integrator should seek to find the optimum balance between performance, risk and cost to achieve the required level of redundancy. Options for available exploration include;

a) Option 1 – Installation of a redundant pair of SEC PLC's where by one SEC PLC acts as master to control the entire sludge truck auto-loading control system. In the event of failure of a SEC PLC component, the system automatically initiates a hot-standby change in control to the standby SEC PLC and initiates an alarm for attention by City Maintenance on both the SEC control system and the existing ABB DCS.

b) Option 2 – Installation of three dedicated SEC PLC's with one SEC PLC dedicated to controlling both East and West sides of each of the three individual bins. The SEC PLC's operate independently to one another as far as practicable and in the event of a failure of an SEC PLC, initiates an alarm for attention by City Maintenance on both the SEC control system and the existing ABB DCS.

Both of the LHMI's, one in the operators control room and one in the truck drivers control and printout room, while specific for the nature of the control should have the option to switch between configurations to enable full control of the system for both City operators and truck drivers in the event of a failure of one of the LHMI's. Failure of a LHMI should initiate an alarm for attention by City Maintenance on both the SEC control system and the existing ABB DCS.

6.4 BRIDGING TO THE ABB DCS INFINET 90 REQUIREMENTS

The SEC PLC registries should be appropriately exposed for use by the ABB DCS. A table of bridging requirements between the SEC PLC and the ABB DCS can be found in Table W700. Note: Expanded tables and available DCS points for use to be provided at contract award.

The ABB DCS should also be able to have a limited set of commands available to be used by the SEC PLC to initiate or override a sequence. The following commands should be;

a) Lock out of a hopper;

b) Lock out of a bin from filling;

c) Emergency shutdown of all the hopper systems;

d) Skip the next SEC PLC determined hopper for the next in sequence;

e) Force the use of a selected hopper for truck loading regardless of how little sludge is available;

f) Force the use of a selected bin for filling from the centrifuge system provided it is safe to do so and space for filling is available. Upon full status, auto-rotation by the SEC PLC will commence in normal automatic mode.

6.5 EXISTING EQUIPMENT AND SELECTED COMMUNICATION PROTOCOLS

Over the decades, areas of equipment and instrumentation have been replaced with more modern pieces since the original installation date. The design of the installation and the control of the SEC PLC should seek to take advantage of the more modern instrumentation that was not available at the time of the originally installed Datum PLC. For example, the weigh scales should use Ethernet communication protocol rather than the existing serial connection that the Datum PLC currently uses. The current printer for the printout to the truck drivers is a standard cash register receipt printer, Ethernet enabled, and should communicate direct with the SEC control system over Ethernet if possible.

A list in order of preferred analogue I/O communication methods to field based equipment from the new SEC PLC system where available is;

1) Ethernet/IP
2) Modbus/TCP
3) Profibus DP
4) Profibus PA
5) HART
6) 4-20 mA

Where practicable, existing analogue inputs should be taken direct to the SEC PLC and the appropriate analogue registries exposed to the ABB DCS. This purpose being to eliminate where possible the current analogue loop splitters which are considered an additional point of failure.

6.6 LHMI REQUIREMENTS

As greatly as possible, the run-time application, set-points etc. to control the sludge auto-loading system should reside within the SEC PLC, not within the SEC LHMI. The intent is that failure of a LHMI(s) will not prevent the system from running as normal in automatic mode.

Graphical displays should be set out as per the City standard WWD HMI Layout and Animation Plan. Further guidance can also be found within the WWD Automation Design Guide.

Both LHMI's should possess the ability to switch between City Operator and Truck Driver modes. There should be three levels of access, the highest level of access being "Engineer", followed by "Operator" followed by "Truck Driver".

a) "Engineer" should have fully enabled access to modify all aspects of the LHMI configuration and run-time application.

b) "Operator" should have access to see all operations and truck driver specific operating pages and modes, and the ability to edit operating variables through user defined fields.

c) "Truck Driver" should have limited access to only the truck loading specific pages of the LHMI. In general, the truck driver should not have the ability to adjust operating set-points other than those required to successfully initiate and receive a load of sludge cake to the truck.

6.6.1 Truck Drivers LHMI

The following list details the minimum requirements for the Truck Drivers LHMI.

a) Each Truck Driver (maximum of 30 individuals) should be assigned an individual 4-digit PIN and all PIN's should be unique and random. The LHMI by default should be locked from accepting commands from the Truck Driver until the personal 4-digit PIN is entered.

b) Upon completion of the sludge load cycle to the truck initiated by the Truck Driver and printing of receipt for that individual load, the Truck Driver should be logged off automatically from the LHMI. Logging in after this point will be as per 6.6.1 a).

c) The LHMI should have one overview page of all six load points and six individual specific load point pages, seven pages in total. Pressing of one of the load points on the overview page should direct the Truck Driver to the specific load point page for that truck.

d) The specific load point pages for each of the load points should have the same layout with a clearly identifiable title at the top of the page to which of the load points it is related too. The specific load point pages should have the following of;

    i. Whether the Bin is currently being filled;
    ii. The total weight of sludge within the Bin;
    iii. The estimated total volume of sludge within the Bin;
    iv. The average density over the preceding twenty four (24) hours previous of the sludge within the Bin;
    v. Whether the Bin is in or out of service and available for filling or dispatch of a load to a truck;
    vi. A user defined switchable field to select either a numeric value load of sludge to be loaded based upon weight or upon volume.
    vii. Two user defined fields to be able to input the licence plate number of the vehicle and the registration number of the trailer to assist in the to enable crosscheck between the receipt and the load manifest.
    viii. Three individual loading buttons. One called “Start” to commence automatic loading of the truck once a value has been inputted into the required weight or volume field to be loaded. One called “Pause” to pause loading that can start or pause loading once the loading cycle has been initiated. One called “Stop” that will stop the loading to the truck and terminate the loading cycle regardless of whether the initial desired weight or volume of the load has been achieved.

ix. During the loading cycle of the truck, the page should display the estimated amount of time left to complete the loading cycle and the estimated current flow rate of sludge to the truck.

x. At the end of a loading cycle, a button that initiates a printout at the receipt printer of the following information:

1. Driver name,
2. Vehicle licence plate number,
3. Vehicle trailer number,
4. Total loading time of loading cycle including times at which the load was paused by truck driver intervention,
5. Time and Date,
6. Weight loaded in kg,
7. Estimated volume loaded in m^3,
8. Other details as required by the Manitoba transport regulations required for a load manifest.

xi. The ability to initiate a re-print of the current receipt or one of the previous ten receipts. Any re-printed ticket should also indicate that it is a re-print of the original.

6.6.2 Operators LHMI

The following list details the minimum requirements for the Operators LHMI located in the operators control room.

a) The look and feel of LHMI should be structured as per the WWD HMI Layout and Animation Plan document.

b) In addition to 6.6.2 a) the Operators LHMI should include the following abilities:

i. To switch between the two LHMI configurations of Operator LHMI and Truck Driver LHMI.

ii. To open, edit and create new Truck Drivers details in the system and assign new 4-digit PINs to the new and existing Truck Drivers.

iii. To manually override and operate any of the auger or valves controlled by the SEC PLC except in the case where a pump is forced to pump against a closed valve.

iv. To manually request the next bay door to be opened.

v. To initiate an emergency shutdown of the facility and to trigger a shutdown of the Centrifuge system controlled by the ABB DCS.

vi. Be able to ascertain which will be the next bin to be filled automatically from the centrifuge process selected by the SEC PLC.

vii. Be able to ascertain which will be the next hopper in use for filling of the next truck in the queue.

6.7 HISTORICAL DATA RETENTION REQUIREMENTS

The new SEC control system is required to log historical data as far as reasonably practicable in line with the WWD Historical Data Retention Standard. In deviation to the WWD Historical Data Retention Standard the system is required to log historical data to the LHMI and SD card storage device within the LHMI. The purpose of this deviation being that the NEWPCC will be installing a new dedicated site Historian under a separate project in the near future and at that time this SEC control system historical data would be stored within the new site Historian.
The LHMI Secure Digital (SD) card should be sized appropriately to store 5 years of data.

All load receipts as per 6.6.1.d.x. are to be stored in a field delimitated text format.

To ensure a level of redundancy of storage data, the data retention should be duplicated across both of the two LHMI's.

The operator should have the ability to download a copy of historical data from the LHMI / SD card to and external Universal Serial Bus (USB) flash drive as a minimum or transfer of data via a network which is the preferred option.

6.8 INDICATION LIGHTING REQUIREMENTS

Two red/green stop/go lights are mounted on the exterior of the building to control the entrance of trucks. Six tri-state traffic lights are located in the interior of the bay area to position trucks under one of the storage bins. The lights should illuminate to indicate the appropriate access by trucks to the appropriate storage bins that is to be gained through one of two truck bay doors on the north side of the truck bay area, namely East and West bays. A further set of overhead doors on the south side of the building allows vehicles to exit the area. These egress doors also have two stop lights mounted nearby to control truck egress.

The tri-state traffic lights under the appropriate bin used for positioning and loading of the truck are to have the following functional states of;

a) Amber – shows the driver which bin has been selected for the driver to use;
b) Green – shows the driver that the truck has successfully moved into the correct position and can be placed into park, and;
c) Red – shows to the driver that the end of the automatic load has been terminated.

The control of the positioning lights and the operation to open and close of the four overhead doors will be done automatically by the SEC PLC. However, the four overhead doors have individual manual override control stations (see locations Figure W704). From here an operator can open and close a door or stop its movement in an emergency stop situation.

In the event of a fault situation, Bins that are related to the fault and as such are out of service should initiate a 500 ms pulsed flash of the three lights (amber, green and red) associated to that Bin, the purpose of which is to indicate to the Truck Driver that there is an issue with the Bins operation.

The operator should have the ability to initiate a lighting test by inputting a manual command into the LHMI which will illuminating all lights within the truck bay for a maximum period of 5 minutes. After 5 minutes has elapsed, the lighting override will be terminated. The illumination of the lights for the test should be done in such a way as to not confuse the truck driver with a false command for loading or failed condition.

6.9 TRUCK PRINTOUT PRINTER REQUIREMENTS

The design of the system should attempt to reuse the existing cash register style printer located in the truck driver specific control room. Communication to the printer should be via Ethernet. The SEC system should be designed in such a way that the printer can be replaced by any other make and model of cash receipt printer in the future without the need for reprogramming of the SEC system.

Upon SEC system restart or upon demand the printer should print a time stamped health statement of the system automation system.

6.10 ENTRY AND EGRESS BAY DOORS

6.10.1 Entry

The entry doors are to be opened by an output from the new SEC PLC after the SEC has selected the appropriate bay for truck loading. The lights external to the building indicating the door usage to the driver are not to be controlled by the SEC PLC. These lights are controlled by the door mechanism position and limits sensors dependent upon the door position. When the SEC PLC orders the door to open or close, it only orders the door mechanism to operate. The lights associated with the door operate upon limit switches attached to the doors.

6.10.2 Egress

The egress door is not to be controlled by the SEC PLC, the egress door is controlled by a separate photocell system independent to the SEC PLC and the SEC PLC is not required to take account of the egress door position or status.

6.11 FAILSAFE REQUIREMENTS

The SEC PLC control system should have the following failsafe consideration:

a) Having the ability to never allow a condition to arise where the system is attempting to move sludge into a dead end or closed valve causing over pressurisation of the system as this will immediately cause irreparable damage to the pumps and augers.

b) The exposed SEC PLC registries should ensure the ABB DCS is clearly able to check for a safe condition for the processes preceding the sludge auto-loading so that if an unsafe condition arises the ABB DCS can safely and in a controlled manor shutdown and inhibit the centrifuge system.

c) Lighting considerations for the direction of trucks and automatic loading should not consider situations where all lights are to be off. This is to eliminate the false direction should a light lamp require replacement.

d) A manual command to place sludge into a bin should not be allowed if the bin is determined to already be full to its maximum design.

e) Upon a cold-start of the system after the SEC PLC is placed into Run mode after being stopped or recommencement after a full power outage, the system should cycle through a peripheral check to ascertain if all equipment is available before placing the system into auto. The event and status of all equipment should be recorded in the historical data.

6.12 MANUAL CONTROL REQUIREMENTS

The six outlet valves are controlled from local pushbutton control panels. Their locations are shown in Figures W705 and W706 and a detail provided in Figure W709. The valve is controlled by a “REMOTE/OFF/HAND” switch. The “OFF” position disconnects all valve control while the “REMOTE” position should surrender control to the SEC PLC. The “HAND” position should allow an operator to manually control the valve using the “OPEN” and “CLOSE” pushbuttons independently of the SEC PLC. The ABB DCS will be required to monitor the valve positions, see the Bridging Table W700.

The twelve screw augers are controlled from different local control panels. Their locations are shown in Figures W705 and W706 and a detail provided in Figure W709. For the auger to be at all operative (either manually or automatically) the system control switch at the bottom of the panel must be in the "ON" position. The auger will then be controlled from the "REMOTE/OFF/HAND" switch. The "OFF" and "HAND" positions allow an operator to locally turn the auger on or off and should be independent of the SEC PLC to operate. The "REMOTE" position should surrender control to the SEC PLC. The ABB DCS will be required to monitor the auger run status, see the Bridging Table W700.

The twenty four discharge valves are also controlled from these same local panels. Here to, the system control switch must be in the "ON" position for the valves to be at all operative. To locally control any of the four valves the valve master control switch must be in the "LOCAL" position. The "REMOTE" position should surrender the control of all four valves to the SEC PLC. In the "LOCAL" mode any of the valves can be controlled using the "OPEN/CLOSE" switch associated with each valve. The ABB DCS will be required to monitor the auger run status and the valve positional statuses, see the Bridging Table W700.

Six local emergency stop pushbuttons dedicated to each of the six independent bin systems are located near each bin discharge chute on the truck bay floor. These buttons should shut down all the equipment associated with each of the six bins. The locations of these buttons are shown in Figure W704.

6.13 AUTOMATIC CONTROL REQUIREMENTS

6.13.1 Bin Filling

The SEC PLC should monitor the level and weight in the bins and control the feed valves to the bins targeting an operator adjustable set point. At the bin maximum carrying capacity specified by the operator, the SEC PLC should select the bin of current minimum fill weight that is available for service, open the feed valve to that bin, and shut the feed valve to the full bin. The SEC PLC should use both level and weight in determining the bin filling capacity. When the

capacity based on level or weight is exceeded, the filling will stop and the next bin is selected. The SEC PLC should allow for a sufficient dead-band within the loading selection so as to not be constantly changing the bin for selected filling.

6.13.2 Sludge Load Out

When a truck arrives outside of the building, the truck driver will request a load by pressing a key-fob similar to a wireless garage door opener. The SEC PLC will receive a digital input to now request a load to be loaded. The SEC PLC will determine which of the bins is the fullest and check to ensure the fill valve is closed and then uses the entrance doors and lights to instruct the driver as to which bin the truck should be positioned under. Proximity sensors in the truck bay floor (see locations Figure W704) tell the SEC PLC when a truck has been correctly positioned at which time it should initiate a light indicator change to signal to the driver to stop the truck in the appropriate position (see lighting section 6.8).

The truck hauler commences the filling by entering his unique 4-digit PIN and following the requirements of section 6.6.1. Once the conditions of 6.6.1 are satisfied, the SEC PLC should open the four discharge valves to fill the truck to the requested amount. Weight sensors or estimated volume as per the request of the driver for the filling process will tell the SEC PLC when to close these valves and end the loading cycle. A time/weight score board should records the weight of the material as the sludge is filling the truck. The score board is used as a manual back-up in case the discharge valves are not closed at the correct weight and the truck driver is required to instigate a manual stop or pause of the loading system as per 6.6.1. The emergency stop pushbutton (see location Figure W704) will immediately shut down the filling process by closing these valves as an alternative worst case scenario. The Emergency stop should instigate a termination “Stop” of the loading cycle and not a “Pause” of the loading cycle. After filling, the SEC PLC should issues a receipt via the printer as per the requirements of section 6.6.1 and 6.9. Once truck loading has been completed and the truck driver has received the receipt for the load, the truck exits the building by triggering photocells.

Cross references between all this equipment and the ABB DCS can be found in Bridging Table W700. Equipment/Instrument Summary Tables W701 to W704 provide a detailed summary of all control, monitoring, and alarm devices associated with this system. A listing of these alarms may be found in Dewatering Building Process Alarms Summary Table W106. Further control information is provided in the Process and Instrumentation Diagram shown in Figure W710.

6.14 Miscellaneous Control Requirements

From time to time trucks will be required to enter the loading bay for non-loading purposes, this may include washing down of the vehicle or storage of the vehicle over-night. The frequency of this event increases during winter months. The SEC PLC system design should consider this operation and differentiate this type of truck movement from a loading request.

6.15 Fault Indications and Scenarios

The following is a minimum list of fault scenarios to be considered and appropriate measure to be developed there of;

a) The truck driver has entered the bay and parked under the SEC PLC selected hopper for use, however the driver is not happy with using the hopper that has been selected by the system for some indeterminate reason not seen by the SEC PLC. The truck driver would then contact the duty City Operator to investigate and the Operator should have the following options of;

    i. Temporary one time hopper lock out, and;

    ii. Permanent hopper lock out.

7 INDIVIDUAL UNITS

a) Sludge Cake Bins

Manufacturer:	Shopost Ltd.

b) Feed Valves - W410-HV, W420-HV, W430-HV, W440-HV, W450-HV, W460-HV

Manufacturer:	Kitz
Size:	304 mm
Type:	S.S. Ball Valve
Class Rating:	900

c) Feed Valves Pneumatic Operator

Manufacturer:	Rotork

d) Feed Valve Limit Switch

Manufacturer:	Westlock
Model:	Eliminator 3030
Type:	SPDT
Voltage:	120-VAC

e) Feed Valve Operator Solenoid

Manufacturer:	ASCO
Model:	8432 4-way
Voltage:	120-VAC

f) Live Bottom Feeders - W412-SCA, W422-SCA, W432-SCA, W442-SCA, W452-SCA, W462-SCA

Manufacturer:	Spiral Engineering Corp.
Motor:	7.5 hp
Voltage:	575 V, 3 ph, 60 Hz
Speed Reducer:	Nord Gear Drive Model SK 6382-132

g) Discharge Knife Gate Valve - W413-HV1, W423-HV1, W433-HV1, W443-HV1, W453-HV1, W463-HV1

Manufacturer:	STAFSJO
Model:	MY-A-400-E-TY

h) Knife Gate Pneumatic Actuator

Manufacturer:	STAFSJO
Model:	AC-250

i) Knife Gate Limit Switches

Manufacturer:	Allan Bradley
Model:	802T-A
Type:	SPDT
Voltage:	120 VAC

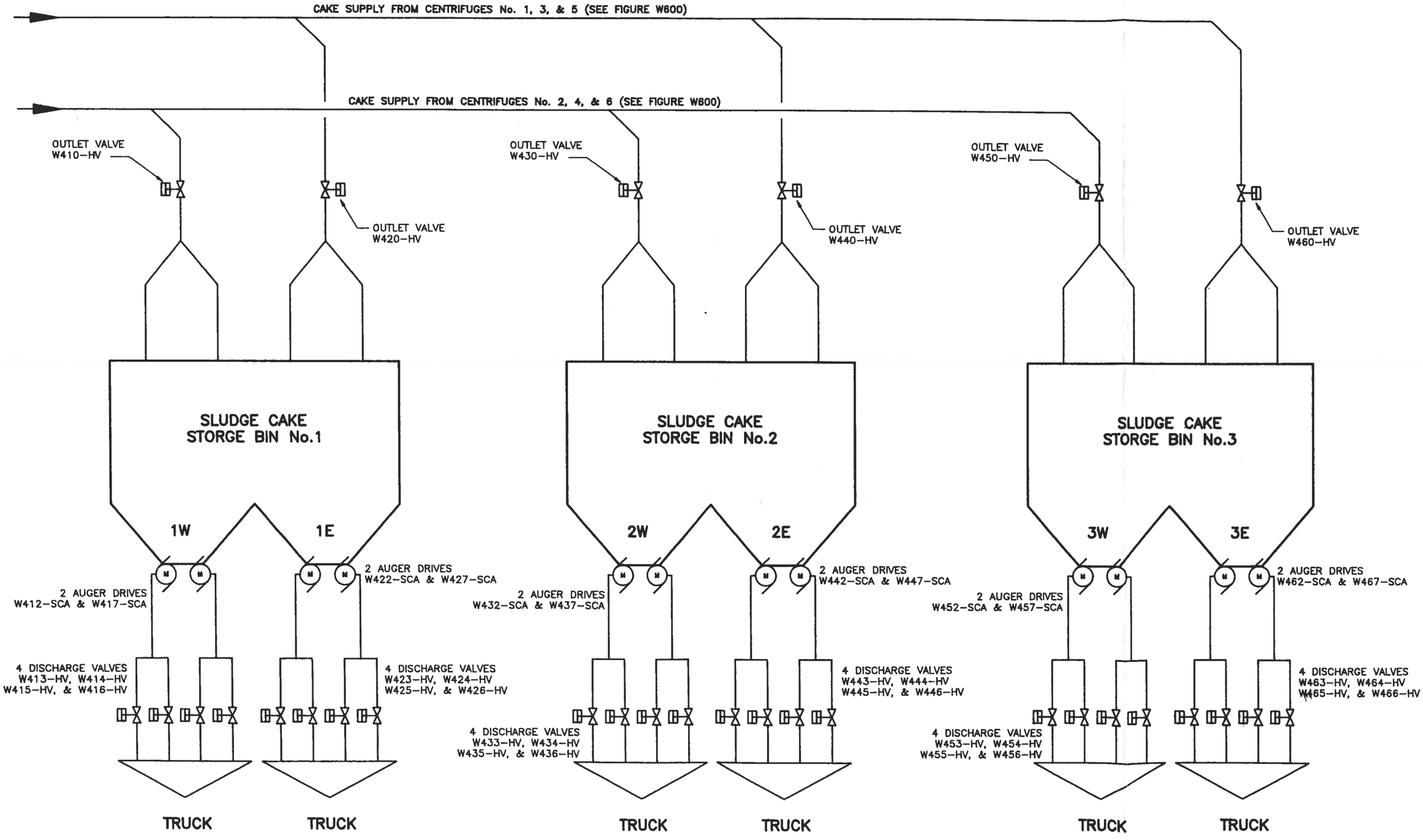
j) Knife Gate Actuator Solenoid Valve

Manufacturer:	Numatics
Type:	MK55-4
Model No.:	554SA43A
Voltage:	120 VA

8 NOTICE

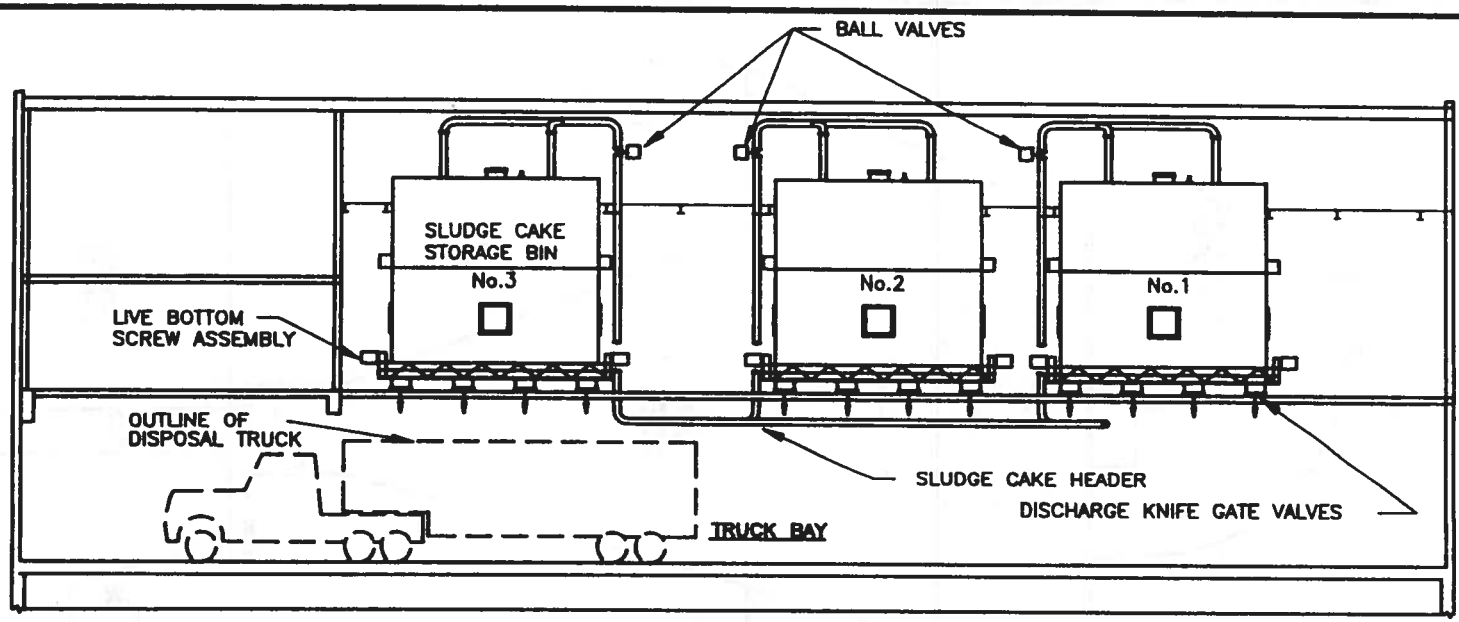
While an extensive attempt has been made to ensure the completeness of the information in this document, there may be minor discrepancies between this document and actual field wiring and programming as minor modifications have arisen over the decades. Where discrepancies are found it will be the responsibility of the systems integrator to identify these discrepancies that place constraint on the successful completion of the project and work with the City in a collaborative method to find resolution.

9 FIGURES AND LOGIC TABLES

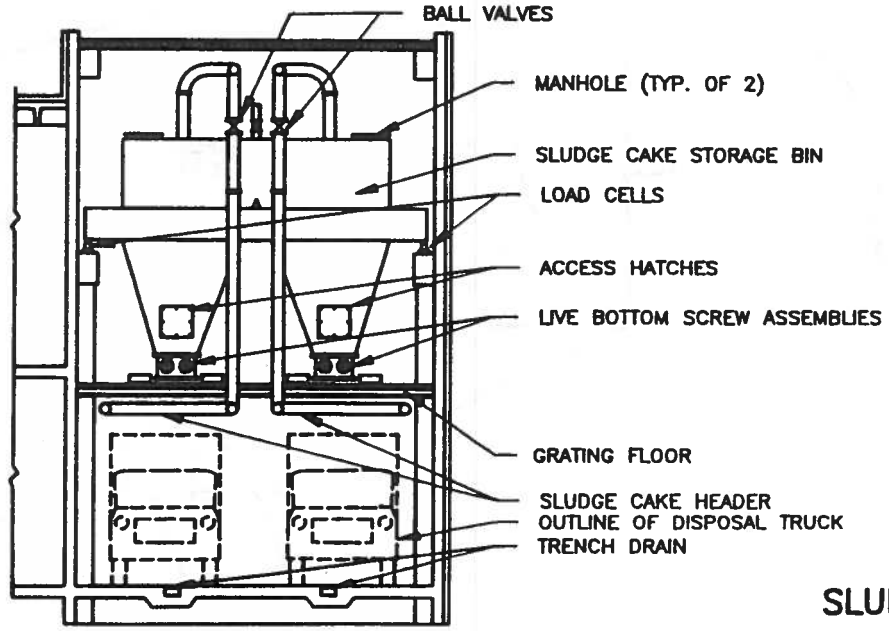


SLUDGE CAKE STORAGE SYSTEM SCHEMATIC

Date : March 1995
Figure W700



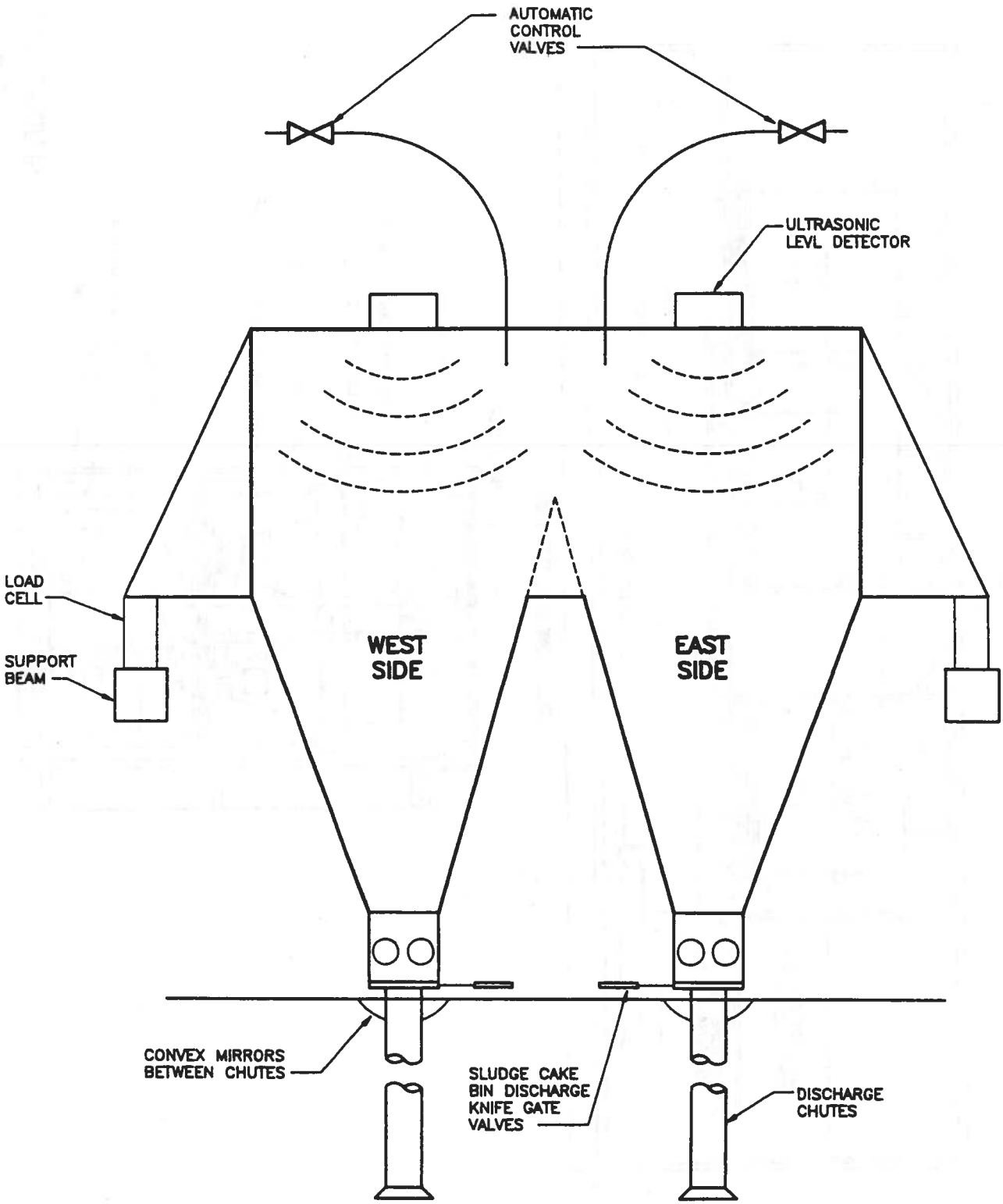
TRUCK BAY EAST ELEVATION



TRUCK BAY END ELEVATION

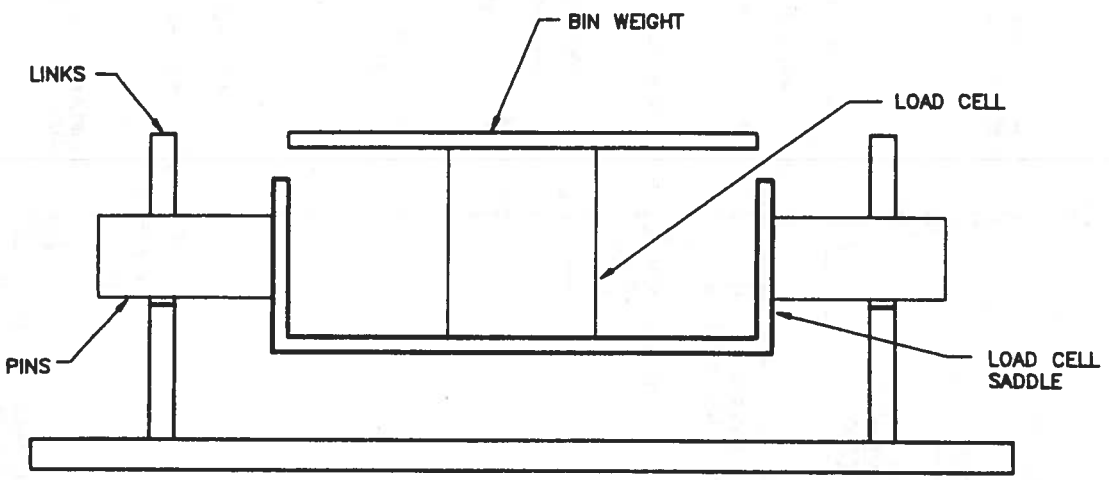
SLUDGE STORAGE SYSTEM

Date : March 1995
Figure W701



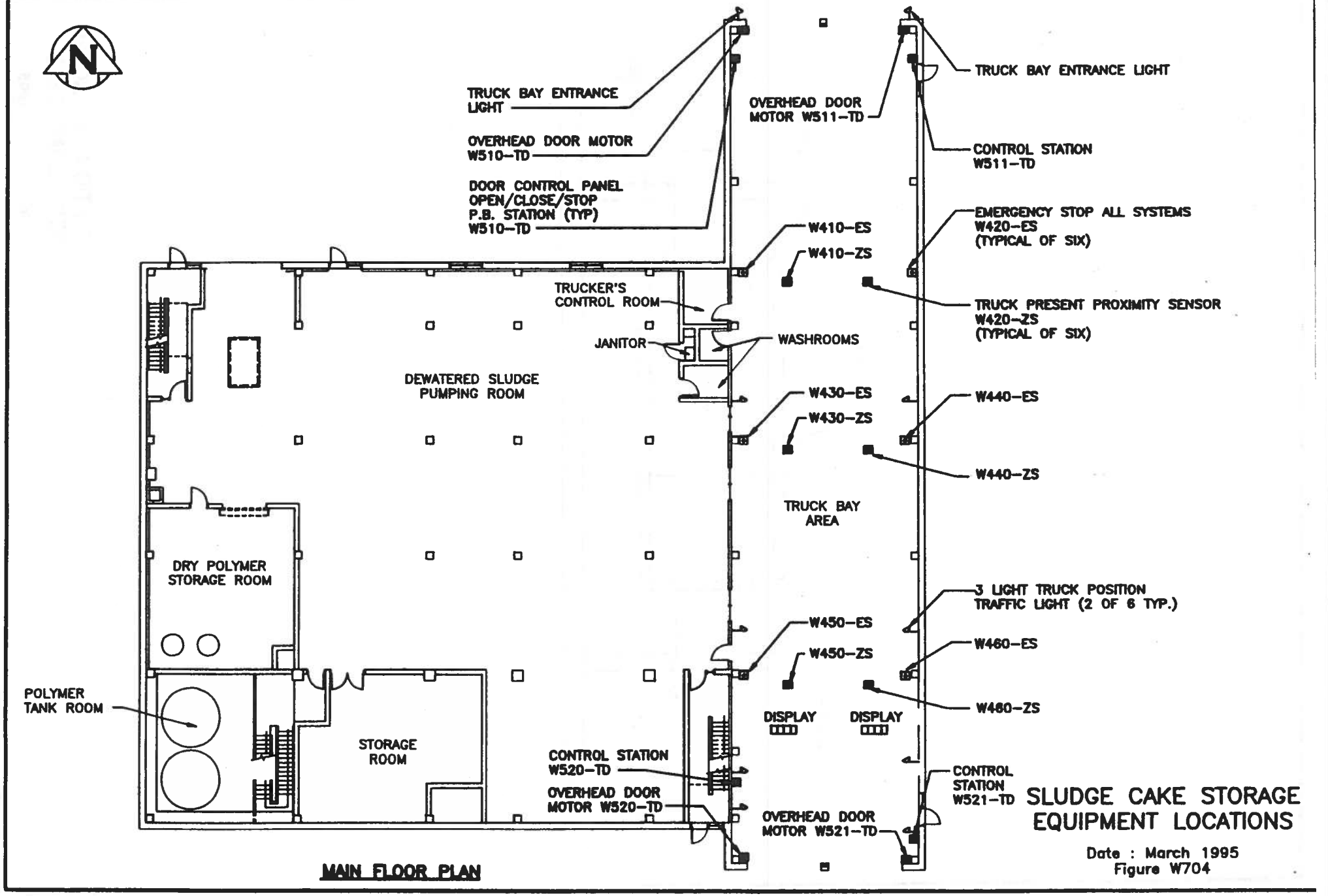
BIN ELEVATION
LOOKING NORTH

Date : March 1995
Figure W702



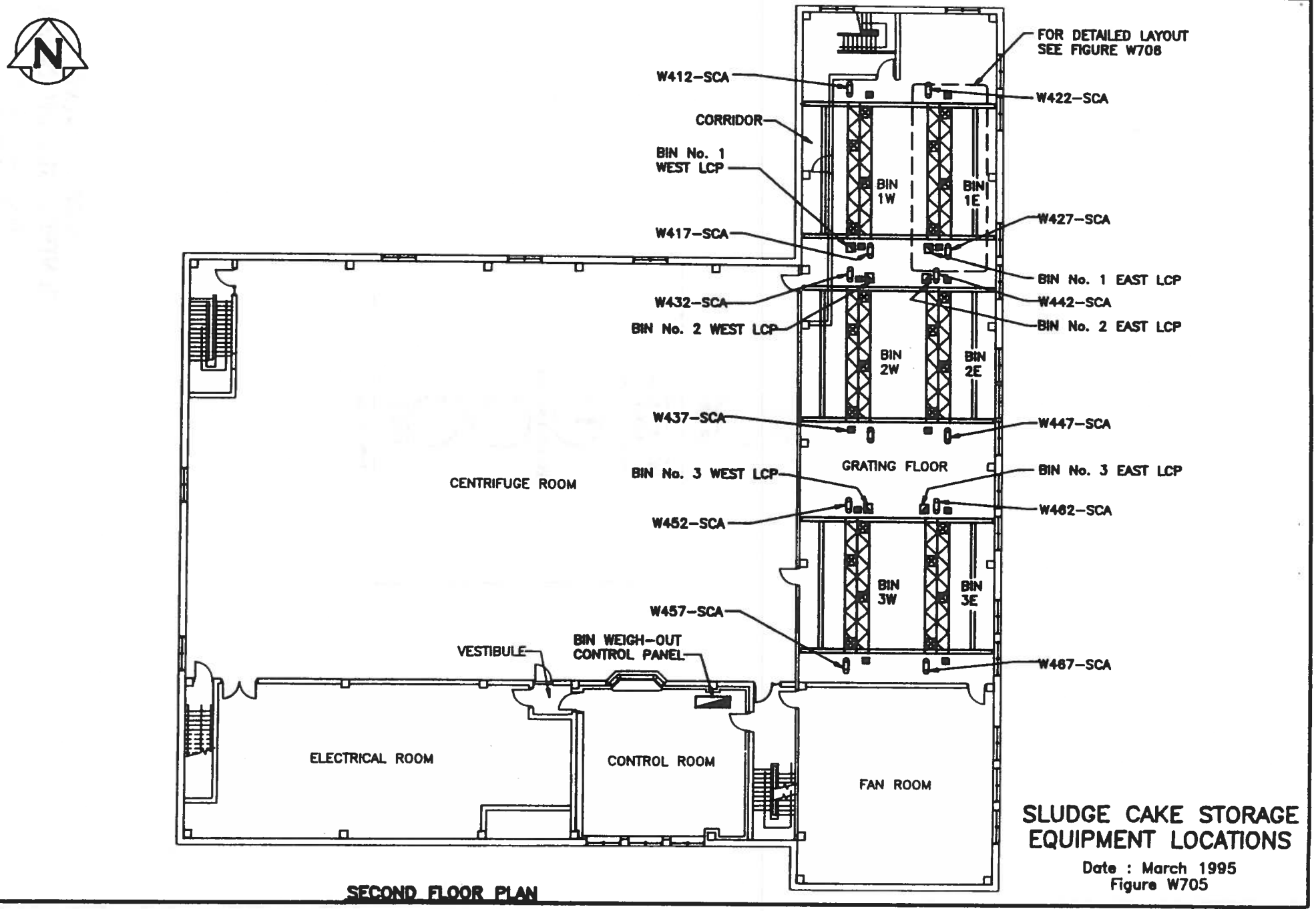
ELEVATION OF SCALE
WITH LOAD CELL

Date : March 1995
Figure W703



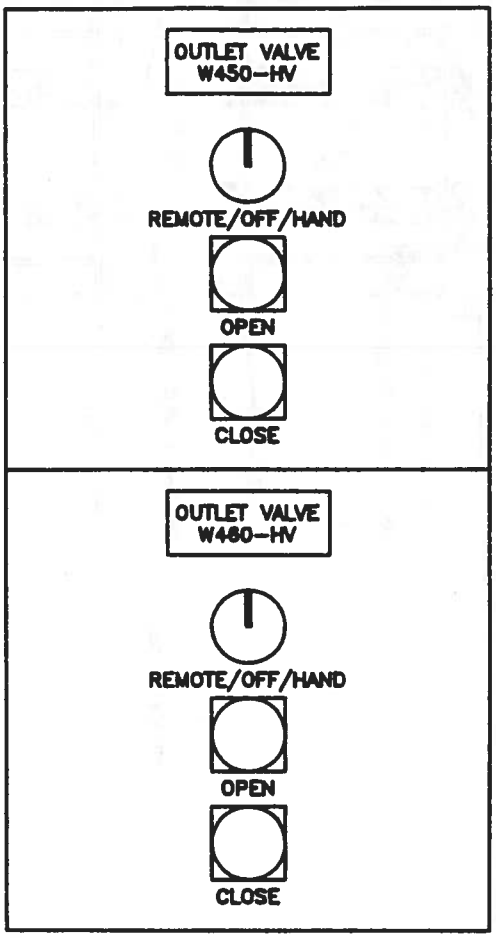
SLUDGE CAKE STORAGE EQUIPMENT LOCATIONS

Date : March 1995
Figure W704



SLUDGE CAKE STORAGE EQUIPMENT LOCATIONS

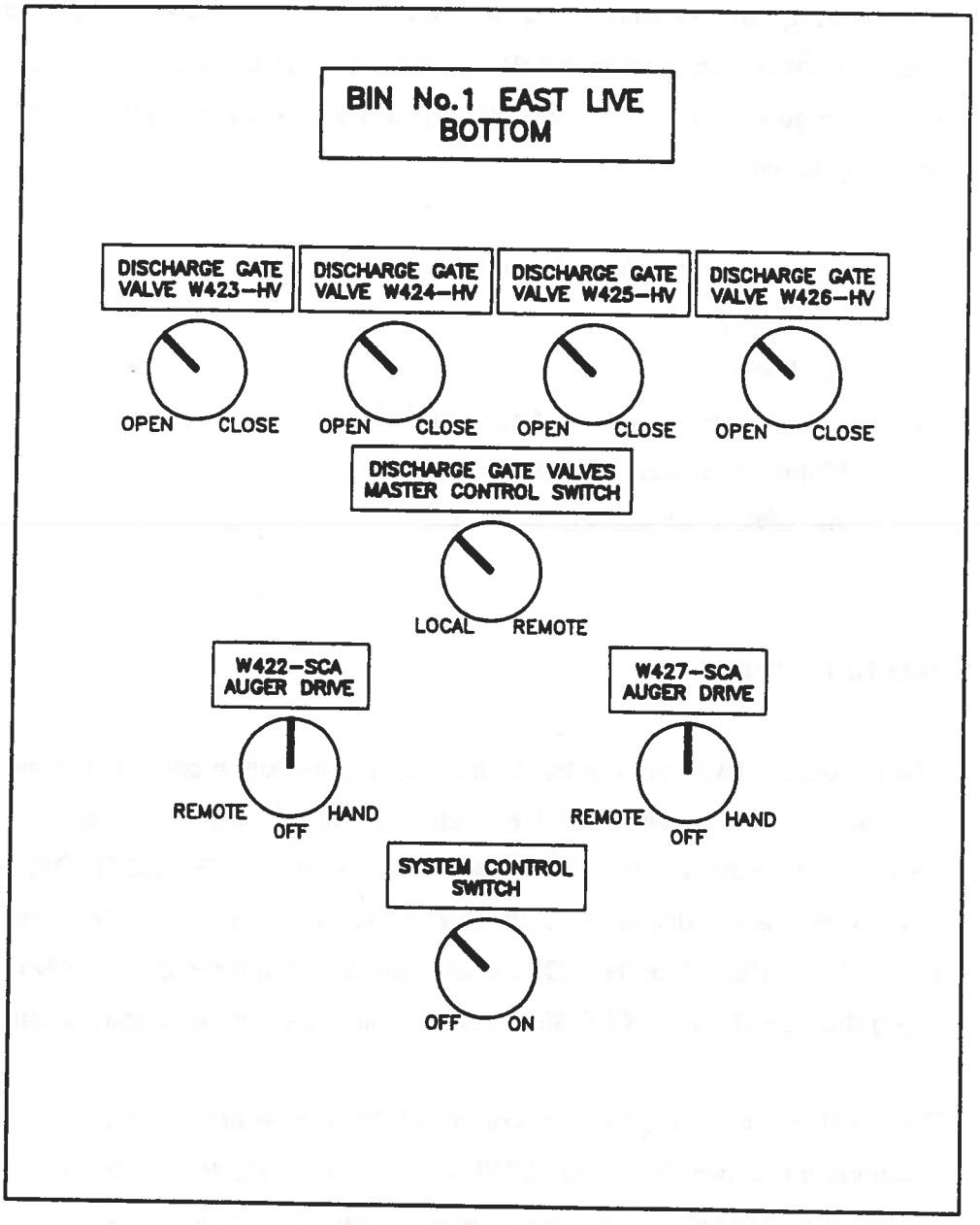
Date : March 1995
Figure W705



TYPICAL OF 3

OUTLET VALVE CONTROL STATION DETAIL

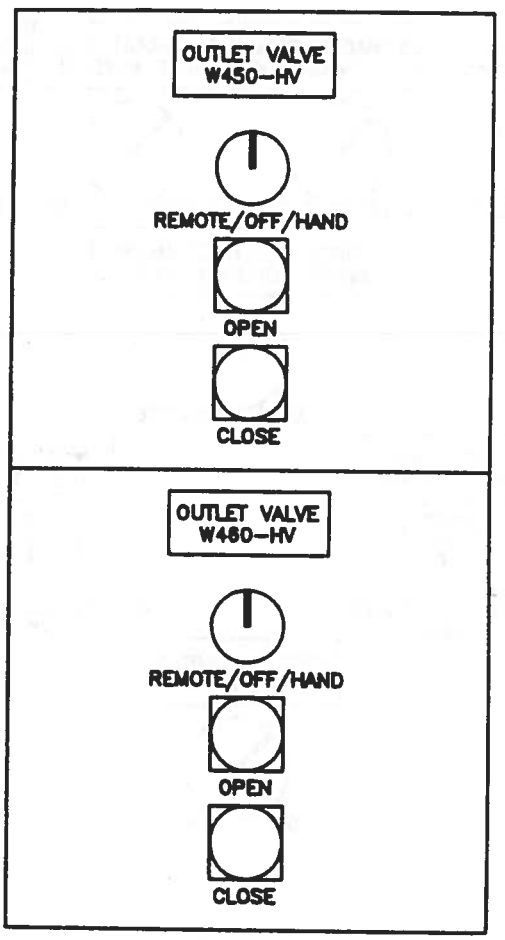
Date : March 1995
Figure W706



TYPICAL OF SIX

BIN No.1 EAST
LOCAL CONTROL PANEL DETAIL

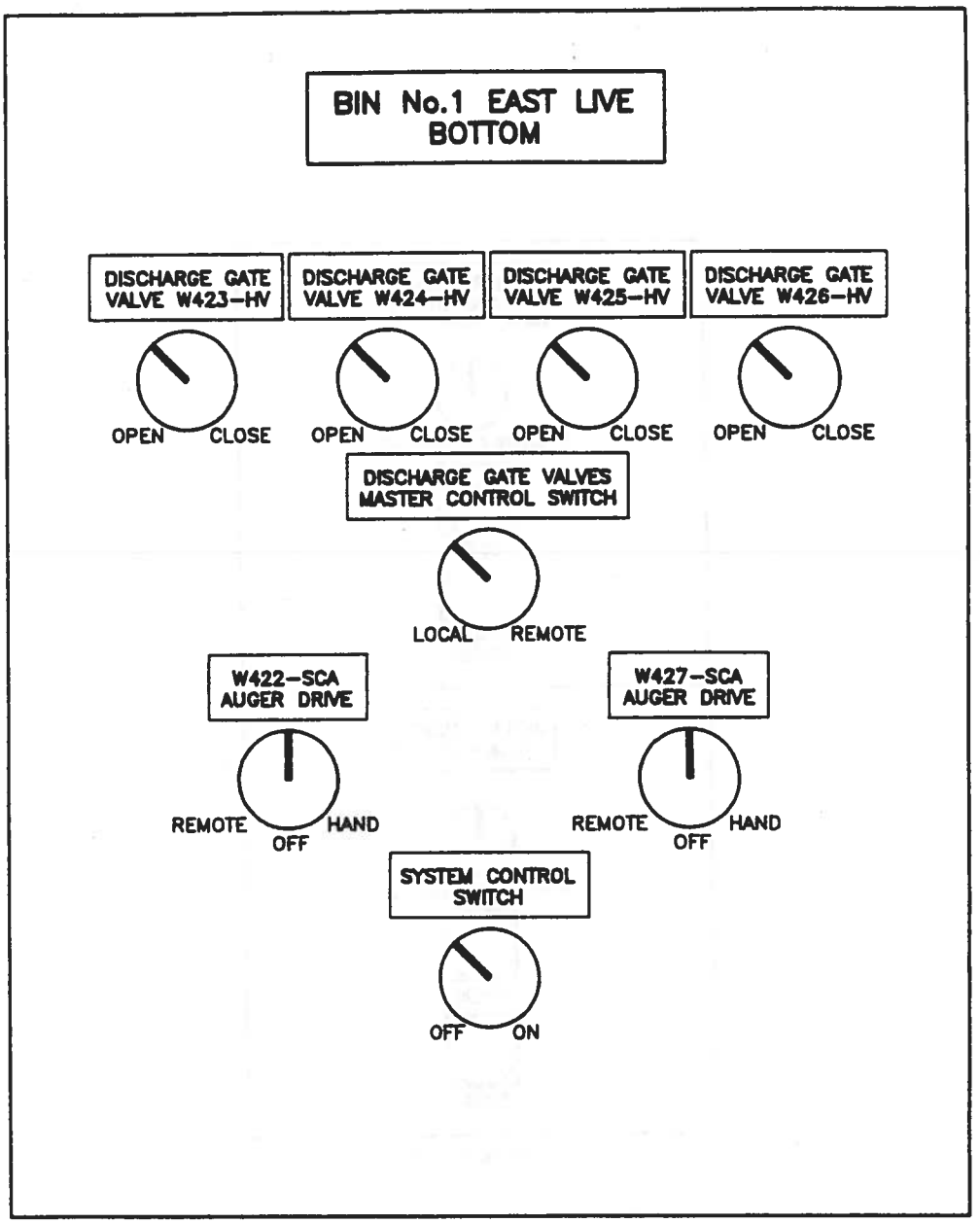
Date : March 1995
Figure W707



TYPICAL OF 3

OUTLET VALVE CONTROL STATION DETAIL

Date : March 1995
Figure W708



TYPICAL OF SIX

BIN No.1 EAST
LOCAL CONTROL PANEL DETAIL

Date : March 1995
Figuer W709

TABLE W700

SLUDGE CAKE STORAGE SYSTEM/N90 BRIDGING TABLE

EQUIPMENT ID NUMBER	GRAPHIC DISPLAYS		GROUP DISPLAYS			
	DISPLAY NUMBER	REMOTE CONTROL INDEX NUMBER	TREND	CONTROL STATION	REMOTE CONTROL SWITCH	SINGLE POINT
W410-HV	9-A, B, V					
W411-LI	9-A, B, V					
W412-SCA	9-B, V					
W413-HV	9-B, V					
W420-HV	9-A, B, V					
W421-LI	9-A, B, V					
W422-SCA	9-B, V					
W423-HV	9-B, V					
W430-HV	9-A, B, V					
W431-LI	9-A, B, V					
W432-SCA	9-B, V					
W433-HV	9-B, V					
W440-HV	9-A, B, V					
W441-LI	9-A, B, V					
W442-SCA	9-B, V					
W443-HV	9-B, V					
W450-HV	9-A, B, V					
W451-LI	9-A, B, V					
W452-SCA	9-B, V					
W453-HV	9-B, V					
W460-HV	9-A, B, V					
W461-LI	9-A, B, V					
W462-SCA	9-B, V					
W463-HV	9-B, V					
W480-QF	9-V					
W481-WI	9-B, V		9-V			
W482-WI	9-B, V		9-V			
W483-WI	9-B, V		9-V			

TABLE W701

SLUDGE CAKE STORAGE BIN NO. 1 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W410-HS	Bin #1W sys cont-emer stop	S					
W410-HS4	Bin #1W sys cont (on/off)		C		I		
W410-HS5	Bin #1W disch valve cont-r/l		C				
W410-HS1	Outlet valve control (R/O/H)	C					
W410-HS2	Outlet valve control (open)	C			C		
W410-HS3	Outlet valve control (close)	C			C		
W410-ZD	Outlet valve status - open				I	I	
W410-ZB	Outlet valve status - closed				I	I	
W412-HS1	Auger #1 control (LOS)	S					
W412-HS2	Auger #1 control (R/O/H)		C				
W412-MM	Auger #1 status - run				I/C	I	
W417-HS1	Auger #2 control (LOS)	S					
W417-HS2	Auger #2 control (R/O/H)		C				
W417-MM	Auger #2 status - run				I/C	I	
W413-HS	Disch valve #1 cont (op/cl)		C		C		
W413-ZD	Disch valve #1 status-open				I	I	
W413-ZB	Disch valve #1 status-close				I	I	
W414-HS	Disch valve #2 cont (op/cl)		C		C		
W414-ZD	Disch valve #2 status-open				I	I	
W414-ZB	Disch valve #2 status-close				I	I	
W415-HS	Disch valve #3 cont (op/cl)		C		C		
W415-ZD	Disch valve #3 status-open				I	I	
W415-ZB	Disch valve #3 status-close				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

(continued)

TABLE W701 (continued)

SLUDGE CAKE STORAGE BIN NO. 1 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W416-HS	Disch valve #4 cont (op/cl)		C		C		
W416-ZD	Disch valve #4 status-open				I	I	
W416-ZB	Disch valve #4 status-close				I	I	
W411-LI	Bin #1W level				I	I	
W420-HS	Bin #1E sys cont-emer stop	S					
W420-HS4	Bin #1E sys cont (on/off)		C				
W420-HS5	Bin #1E disch valve cont-r/l		C				
W420-HS1	Outlet valve control (R/O/H)	C					
W420-HS2	Outlet valve control (open)	C			C		
W420-HS3	Outlet valve control (close)	C			C		
W420-ZD	Outlet valve status - open				I	I	
W420-ZB	Outlet valve status - closed				I	I	
W422-HS1	Auger #1 control (LOS)	S					
W422-HS2	Auger #1 control (R/O/H)		C				
W422-MM	Auger #1 status - run				I/C	I	
W427-HS1	Auger #2 control (LOS)	S					
W427-HS2	Auger #2 control (R/O/H)		C				
W427-MM	Auger #2 status - run				I/C	I	
W423-HS	Disch valve #1 cont (op/cl)		C		C		
W423-ZD	Disch valve #1 status-open				I	I	
W423-ZB	Disch valve #1 stat-closed				I	I	
W424-HS	Disch valve #2 cont (op/cl)		C		C		
W424-ZD	Disch valve #2 status-open				I	I	
W424-ZB	Disch valve #2 stat-closed				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

(continued)

TABLE W701 (continued)

SLUDGE CAKE STORAGE BIN NO. 1 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W425-HS	Disch valve #3 cont (op/cl)		C		C		
W425-ZD	Disch valve #3 status-open				I	I	
W425-ZB	Disch valve #3 stat-closed				I	I	
W426-HS	Disch valve #4 cont (op/cl)		C		C		
W426-ZD	Disch valve #4 status-open				I	I	
W427-ZB	Disch valve #4 stat-closed				I	I	
W421-LI	Bin #1E level				I	I	
W481-WI	Bin #1 weight				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

TABLE W702

SLUDGE CAKE STORAGE BIN NO. 2 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W430-HS	Bin #2W sys cont-emer stop	S					
W430-HS4	Bin #2W sys cont (on/off)		C		I		
W430-HS5	Bin #2W disch valve cont-r/l		C				
W430-HS1	Outlet valve control (R/O/H)	C					
W430-HS2	Outlet valve control (open)	C			C		
W430-HS3	Outlet valve control (close)	C			C		
W430-ZD	Outlet valve status - open				I	I	
W430-ZB	Outlet valve status - closed				I	I	
W432-HS1	Auger #1 control (LOS)	S					
W432-HS2	Auger #1 control (R/O/H)		C				
W432-MM	Auger #1 status - run				I/C	I	
W437-HS1	Auger #2 control (LOS)	S					
W437-HS2	Auger #2 control (R/O/H)		C				
W437-MM	Auger #2 status - run				I/C	I	
W433-HS	Disch valve #1 cont (op/cl)		C		C		
W433-ZD	Disch valve #1 status-open				I	I	
W433-ZB	Disch valve #1 stat-closed				I	I	
W434-HS	Disch valve #2 cont (op/cl)		C		C		
W434-ZD	Disch valve #2 status-open				I	I	
W434-ZB	Disch valve #2 stat-closed				I	I	
W435-HS	Disch valve #3 cont (op/cl)		C		C		
W435-ZD	Disch valve #3 status-open				I	I	
W435-ZB	Disch valve #3 stat-closed				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

(continued)

TABLE W702 (continued)

SLUDGE CAKE STORAGE BIN NO. 2 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W436-HS	Disch valve #4 cont (op/cl)		C		C		
W436-ZD	Disch valve #4 status-open				I	I	
W436-ZB	Disch valve #4 stat-closed				I	I	
W431-LI	Bin #4W level				I	I	
W440-HS	Bin #4E sys cont-emer stop	S					
W440-HS4	Bin #4E sys cont (on/off)		C				
W440-HS5	Bin #4E disch valve cont-r/l		C				
W440-HS1	Outlet valve control (R/O/H)	C					
W440-HS2	Outlet valve control (open)	C			C		
W440-HS3	Outlet valve control (close)	C			C		
W440-ZD	Outlet valve status - open				I	I	
W440-ZB	Outlet valve status - closed				I	I	
W442-HS1	Auger #1 control (LOS)	S					
W442-HS2	Auger #1 control (R/O/H)		C				
W442-MM	Auger #1 status - run				I/C	I	
W447-HS1	Auger #2 control (LOS)	S					
W447-HS2	Auger #2 control (R/O/H)		C				
W447-MM	Auger #2 status - run				I/C	I	
W443-HS	Disch valve #1 cont (op/cl)		C		C		
W443-ZD	Disch valve #1 status-open				I	I	
W443-ZB	Disch valve #1 status-close				I	I	
W444-HS	Disch valve #2 cont (op/cl)		C		C		
W444-ZD	Disch valve #2 status-open				I	I	
W444-ZB	Disch valve #2 status-close				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

(continued)

TABLE W702 (continued)

SLUDGE CAKE STORAGE BIN NO. 2 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W445-HS	Disch valve #3 cont (op/cl)		C		C		
W445-ZD	Disch valve #3 status-open				I	I	
W445-ZB	Disch valve #3 status-close				I	I	
W446-HS	Disch valve #4 cont (op/cl)		C		C		
W446-ZD	Disch valve #4 status-open				I	I	
W447-ZB	Disch valve #4 status-close				I	I	
W441-LI	Bin #2E level				I	I	
W482-WI	Bin #2 weight				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

TABLE W703

SLUDGE CAKE STORAGE BIN NO. 3 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W450-HS	Bin #3W sys cont-emer stop	S					
W450-HS4	Bin #3W sys cont (on/off)		C		I		
W450-HS5	Bin #3W disch valve cont-r/l		C				
W450-HS1	Outlet valve control (R/O/H)	C					
W450-HS2	Outlet valve control (open)	C			C		
W450-HS3	Outlet valve control (close)	C			C		
W450-ZD	Outlet valve status - open				I	I	
W450-ZB	Outlet valve status - closed				I	I	
W452-HS1	Auger #1 control (LOS)	S					
W452-HS2	Auger #1 control (R/O/H)		C				
W452-MM	Auger #1 status - run				I/C	I	
W457-HS1	Auger #2 control (LOS)	S					
W457-HS2	Auger #2 control (R/O/H)		C				
W457-MM	Auger #2 status - run				I/C	I	
W453-HS	Disch valve #1 cont (op/cl)		C		C		
W453-ZD	Disch valve #1 status-open				I	I	
W453-ZB	Disch valve #1 status-close				I	I	
W454-HS	Disch valve #2 cont op/cl)		C		C		
W454-ZD	Disch valve #2 status-open				I	I	
W454-ZB	Disch valve #2 status-close				I	I	
W455-HS	Disch valve #3 cont (op/cl)		C		C		
W455-ZD	Disch valve #3 status-open				I	I	
W455-ZB	Disch valve #3 status-close				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

(continued)

TABLE W703 (continued)

SLUDGE CAKE STORAGE BIN NO. 3 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W456-HS	Disch valve #4 cont (op/cl)		C		C		
W456-ZD	Disch valve #4 status-open				I	I	
W456-ZB	Disch valve #4 status-close				I	I	
W451-LI	Bin #3W level				I	I	
W460-HS	Bin #3E sys cont-emer stop	S					
W460-HS4	Bin #3E sys cont (on/off)		C				
W460-HS5	Bin #3E disch valve cont-r/l		C				
W460-HS1	Outlet valve control (R/O/H)	C					
W460-HS2	Outlet valve control (open)	C			C		
W460-HS3	Outlet valve control (close)	C			C		
W460-ZD	Outlet valve status - open				I	I	
W460-ZB	Outlet valve status-closed				I	I	
W462-HS1	Auger #1 control (LOS)	S					
W462-HS2	Auger #1 control (R/O/H)		C				
W462-MM	Auger #1 status - run				I/C	I	
W467-HS1	Auger #2 control (LOS)	S					
W467-HS2	Auger #2 control (R/O/H)		C				
W467-MM	Auger #2 status - run				I/C	I	
W463-HS	Disch valve #1 cont (op/cl)		C		C		
W463-ZD	Disch valve #1 status-open				I	I	
W463-ZB	Disch valve #1 status-close				I	I	
W464-HS	Disch valve #2 cont (op/cl)		C		C		
W464-ZD	Disch valve #2 status-open				I	I	
W464-ZB	Disch valve #2 status-close				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

(continued)

TABLE W703 (continued)

SLUDGE CAKE STORAGE BIN NO. 3 EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W465-HS	Disch valve #3 cont (op/cl)		C		C		
W465-ZD	Disch valve #3 status-open				I	I	
W465-ZB	Disch valve #3 status-close				I	I	
W466-HS	Disch valve #4 cont (op/cl)		C		C		
W466-ZD	Disch valve #4 status-open				I	I	
W467-ZB	Disch valve #4 status-close				I	I	
W461-LI	Bin #3E level				I	I	
W483-WI	Bin #3 weight				I	I	

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.

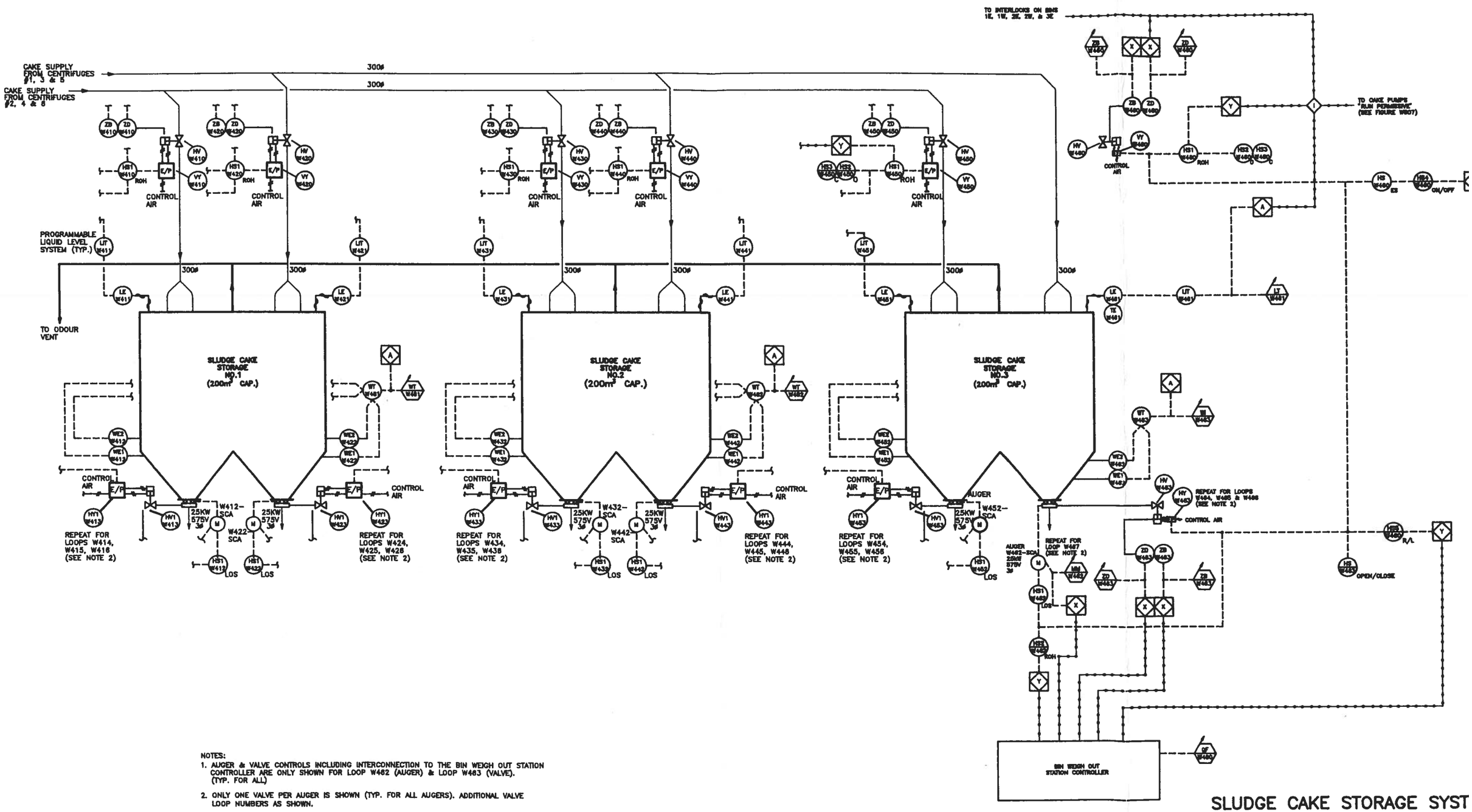
TABLE W704

SLUDGE CAKE LOADOUT SYSTEM EQUIPMENT/INSTRUMENT SUMMARY

INSTR TAG NO.	SERVICE	LOCAL	LOCAL PANEL	FDP-M	PLC	BAILEY N-90	REMARKS NORMAL RANGE SET POINT
W510-HS	Truck bay door cont (O/C/S)	C			C		
W511-HS	Truck bay door cont (O/C/S)	C			C		
W520-HS	Truck bay door cont (O/C/S)	C			C		
W521-HS	Truck bay door cont (O/C/S)	C			C		
W410-ZS	Proximity sensor	C					
W420-ZS	Proximity sensor	C					
W430-ZS	Proximity sensor	C					
W440-ZS	Proximity sensor	C					
W450-ZS	Proximity sensor	C					
W460-ZS	Proximity sensor	C					

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET Q - COMMON ALARM

All instruments on this page found in Figure W710.



NOTES:

1. AUGER & VALVE CONTROLS INCLUDING INTERCONNECTION TO THE BIN WEIGH OUT STATION CONTROLLER ARE ONLY SHOWN FOR LOOP W482 (AUGER) & LOOP W483 (VALVE). (TYP. FOR ALL)
2. ONLY ONE VALVE PER AUGER IS SHOWN (TYP. FOR ALL AUGERS). ADDITIONAL VALVE LOOP NUMBERS AS SHOWN.

SLUDGE CAKE STORAGE SYST
PROCESS & INSTR. DIAGRA

Date : March 1995
Figure W710