



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

January 24, 1987

SUBJECT: University of Iowa, Iowa City, Iowa
Selection of Structure Dimensions for Input to ISCST Model

FROM: Richard L. Daye, Regional Meteorologist *Richard L. Daye*

TO: Joseph A. Tikvart, Chief
Source Receptor Analysis Branch (MD-14)

This is a request for the modeling clearing house to review our logic for determining appropriate structure dimensions for input to the Industrial Source Complex Short-Term (ISCST) model. The stack heights involved are less than good engineering practice (GEP) stack height so possible wake effects must be considered. Although our procedure is based on the recommended EPA method to calculate GEP stack heights, we want to ensure that it is consistent with the procedures used in other regions.

BACKGROUND

During our evaluation of a prevention of significant (PSD) permit application for a new boiler for the University of Iowa, Iowa City, Iowa, we determined that the building dimensions that the consultant selected as input to the ISCST model were not the dimensions that we would have selected. The building dimensions were independently chosen by the consultant and Region VII after consideration of the wind flow, all the structures, the location of the sources, and the area where maximum concentrations were expected.

There are proposed silos adjacent to the proposed power house. They are located north of the lower portions of the power house and northeast of the highest portions. The silos are located north of the new stack. The direction from the proposed stack to the most critical receptor is about 303 degrees. The direction from the existing stack serving boilers 5 and 6 is about 295 degrees to this critical receptor. The stacks are about 22 meters apart. The plume from the proposed boiler passes over the higher portion of the power house. The wind flow affecting the plume from boilers 5 and 6 passes over the power house as well as passing over the silos. The power house consists of several tiers. The attached figures show the radials from the stacks to the critical receptor as well as the locations of the stacks and buildings.

TECHNIQUE

We believe that the proposed boiler house must be considered as well as the silos when selecting building dimensions that will affect the

plume from boilers 5 and 6. This is consistent with the tiered and complex structures discussed in the Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), (Revised), EPA-450/4-80-023R, June 1985, the Industrial Source Complex (ISC) Dispersion Model User's Guide - Second Edition, Volume I, EPA-450/4-86-005a, June 1986, and the Regional Workshops on Air Quality Modeling: A Summary Report, Appendix C, EPA-450/4-82-015, April 1981; (Revised) October 1983.

As you can see from the attached figures, there are several possible widths that can be selected. We believe that the power house height of 30.48 meters and a width of 40.49 meters are appropriate parameters for boilers 5 and 6. A height of 30.48 meters and a width of 41.71 meters are appropriate for boilers number 10 and 11. These widths include the width of the silos upwind of the stack serving boilers 5 and 6 but the height is restricted to the height of the power house; i.e., the width of the silo complex is used but the height of the silos is considered to be "chopped" to the height of the power house. The silo complex and the power house are considered to influence each of these stacks. In the ISCST model, once the calculated, or equivalent, width exceeds the structure height, any increase in the width does not effect the concentration. We consider the width of the structure to dominate rather than the horizontal surface area; i.e., the downwind extend of the structure is subordinate to the crosswind width. Although the fetch over the structures varies considerably, the crosswind width and the height of the structures determine the wake effects rather than the length of fetch. Therefore fictitious dimensions are used as input to the ISCST model so that the model will generate the desired crosswind width. All the stacks are well within five structure heights, or widths, of the obstructions. In the case of the stack for the proposed boiler # 11 located upwind of the higher portion of the power house, it is close enough to this portion so that its plume will be affected by the wake area caused by the higher portion.

The university's consultant believes that the dimensions of the the silo complex have the major influence on the stack serving boilers 5 and 6 and that only the silo dimensions must be used on this stack. The consultant used a height of 39.60 meters and a width/length of 13.40 meters; i.e., the dimensions of the silo complex as the influencing structure for boilers 5,6. Structure dimensions affecting stacks 7, 8, 9, 10, and 11 were 28.60 meters for the height and 25.60-, 22.00 meters for the length and width. The consultant believes that actual structure dimensions must be used as input to the ISCST model and that the width calculated by the model does not need to be the crosswind wind. We believe that the model should use the actual crosswind width when determining wake effects and in this case fictitious dimensions must be used so the model can calculate the appropriate crosswind width.

ACTION

We would like your comments on, and/or support of, our procedure for determining the proper structure dimensions for input to the ISCST model.

ADDENDUM 1 - January 23, 1987

The design of the installation has been altered as indicated on attachment 2. Although some of the heights and widths of the influencing structures have changed, the concept of selecting the proper dimensions have not.

ADDENDUM 2 - January 26, 1987

Attachment 3 contains the latest changes that we have received from the consultant. Although the heights have changed, the concepts on how to calculate appropriate dimensions for input to the ISCST have not. Our recommended structure dimensions, based on this new information from the consultant and the location of the receptor, for input to the ISCST model are:

SOURCE/STACK	STRUCTURE HEIGHT (M)	LENGTH & WIDTH* (M)
Boiler 5,6	30.48	35.88
Boilers 7 & 8 (Gas Fired)	30.48	35.88
Boiler 10	30.48	36.96
Boiler 11	30.48	36.96

*Selected so the ISCST model calculates the appropriate crosswind diameter

Elevation drawings are expected from the consultant so the actual demensions may change. However, the concept of using the crosswind width will not change.

STRUCTURE DIMENSIONS - UNIVERSITY OF IOWA, IOWA CITY, IOWA

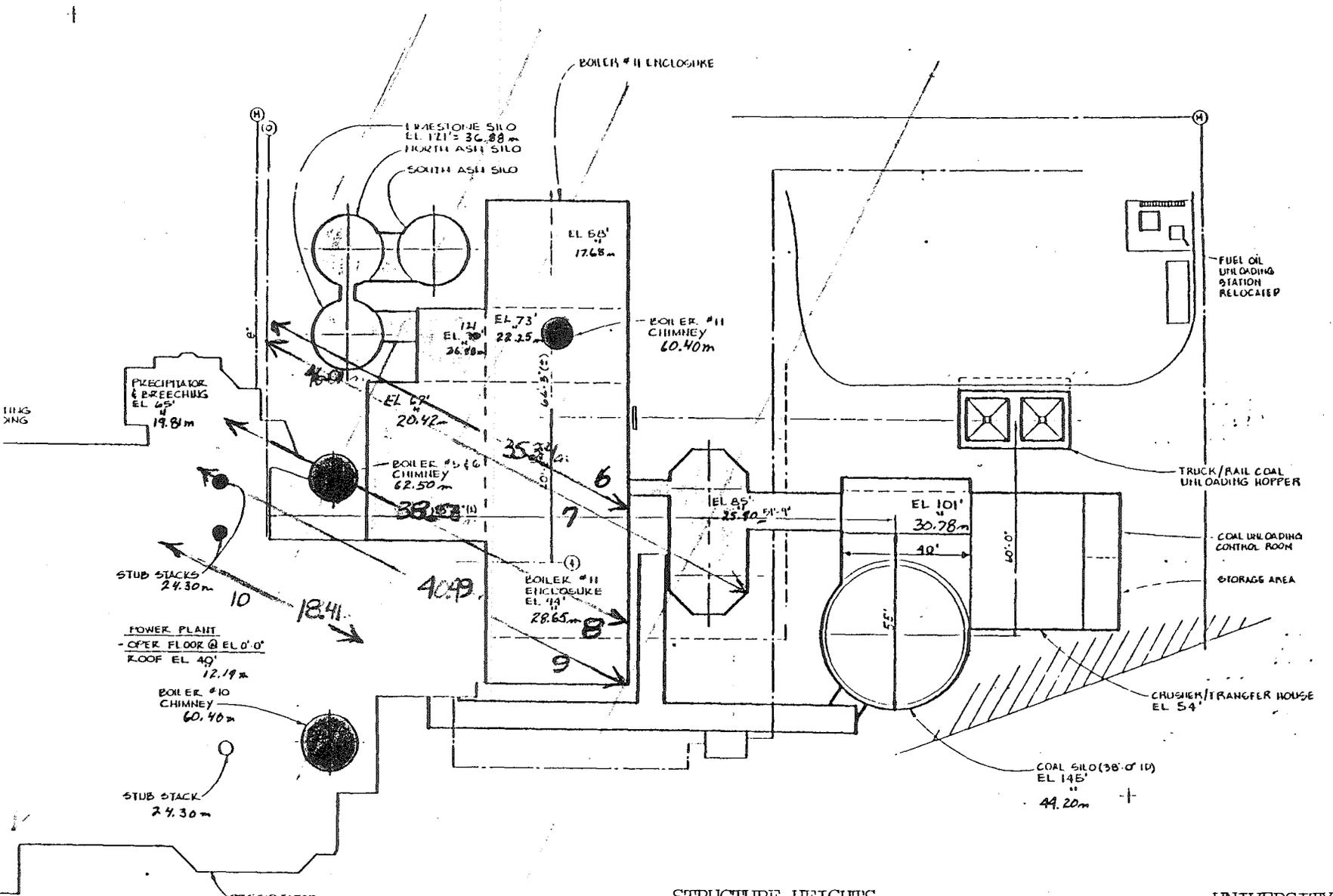
WIDTH NUMBER	STRUCTURE	WIDTH (M)	HEIGHT (M)	*GEP HEIGHT (M)	STACK WIND DIRECTION (DEG)	EQUIVALENT WIDTH (M)	STACK/ BOILER
1	Power House	25.76	28.65	67.29	120	22.83	10,11
1+	Power House plus Silos	35.58	28.65	71.63	120	31.58	10,11
2	Power House plus Silos	31.90	28.65	71.63	120	28.27	10,11
2+	Power House plus Silos	41.71	28.65	71.63	120	36.96	10,11
3	Power House	25.15	28.65	66.38	115	22.29	5-6
3+	Power House plus Silos	34.35	28.65	71.63	115	30.44	5-6
4	Silos	12.88	36.88	56.20	115	11.41	5-6
5	Power House plus Silos	40.49	28.65	71.63	115	35.88	5-6
* * * * *							
6	Power House plus Silos	35.34	28.65	71.63	115	31.32	5-6
7	Power House plus Silos & Existing Silos	46.01	25.91	64.78	115	40.78	5-6
8	Power House plus Silos	38.03	28.65	71.63	115	33.70	5-6
9	Power House plus Silos	40.49	28.65	71.63	115	35.88	All
10	Silos	18.41	36.88	64.50	115	16.32	5-6
* * * * *							
**11	Power House plus Silos	40.49	30.48	76.20	115	35.88	5-6
**12	Power House plus Silos	41.71	30.48	76.20	300	36.96	10-11

*GEP = H + 1.5 (<H,W)

**Region VII's recommended parameters

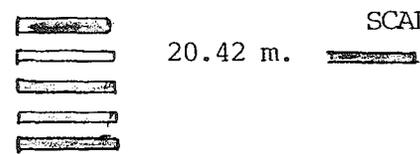
The above widths are derived from Figure 2, PLANT LAYOUT KEY PLAN, submitted by the University of Iowa as part the univerisity's PSD permit application. Widths 1 - 5 are shown on attachment 1; widths 6-10 are shown on attachment 2; Widths 11-12 are shown on attachment 3.

"Equivalent Width" is the length/width used as input to the Industrial Source Complex Short-Term model to simulate the structure's width affecting the source.



STRUCTURE HEIGHTS

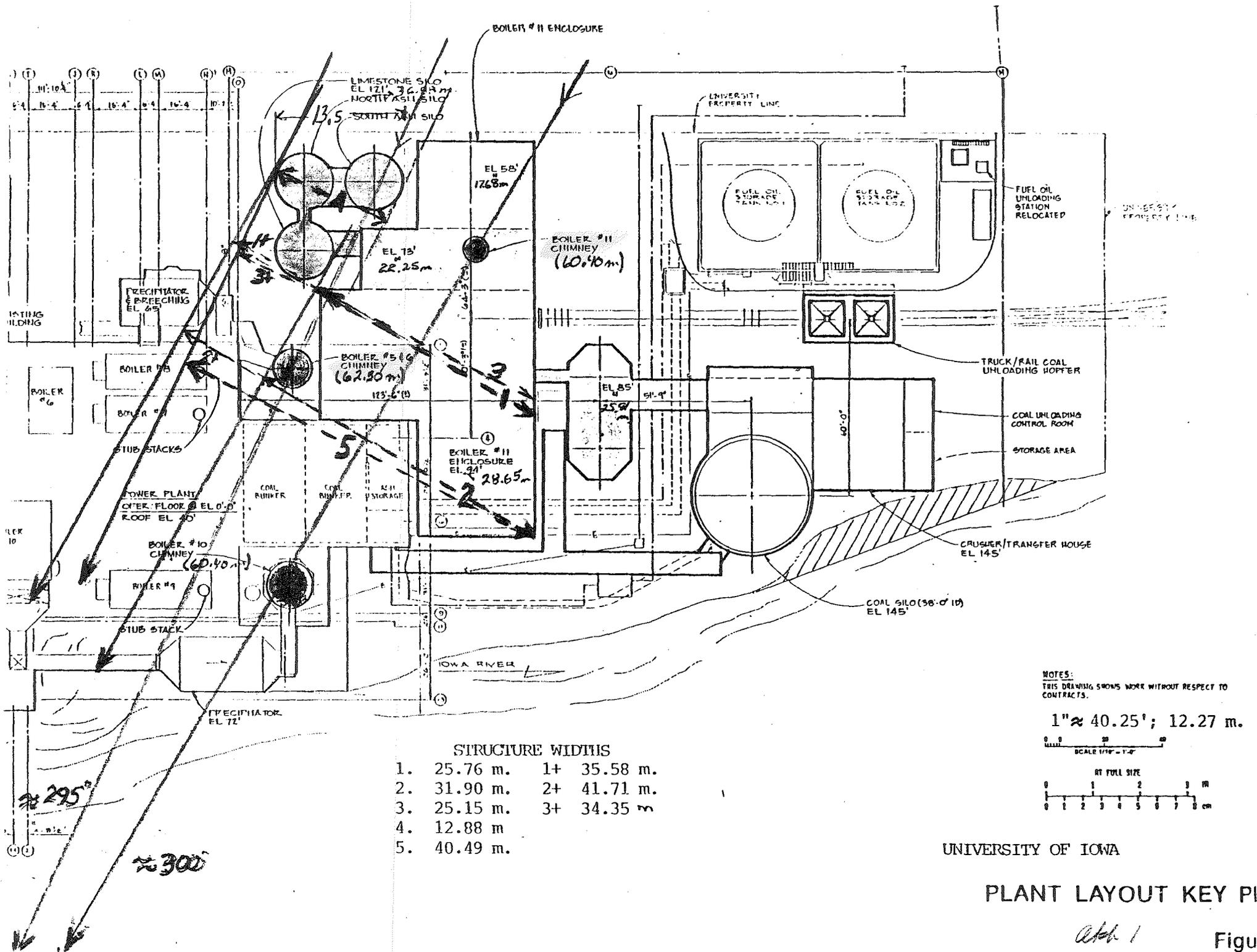
- PROPOSED SILOS 36.88 m.
- PROPOSED POWER HOUSE 17.68 m.
- 22.25 m.
- 28.65 m.
- EXISTING SILOS 25.90 m.



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 SCALE: 1" = 40.25'; 12.27m.

PLANT LAYOUT KEY PLAN

28
 295°

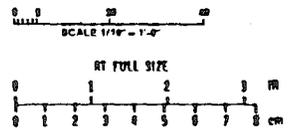


STRUCTURE WIDTHS

1.	25.76 m.	1+	35.58 m.
2.	31.90 m.	2+	41.71 m.
3.	25.15 m.	3+	34.35 m.
4.	12.88 m		
5.	40.49 m.		

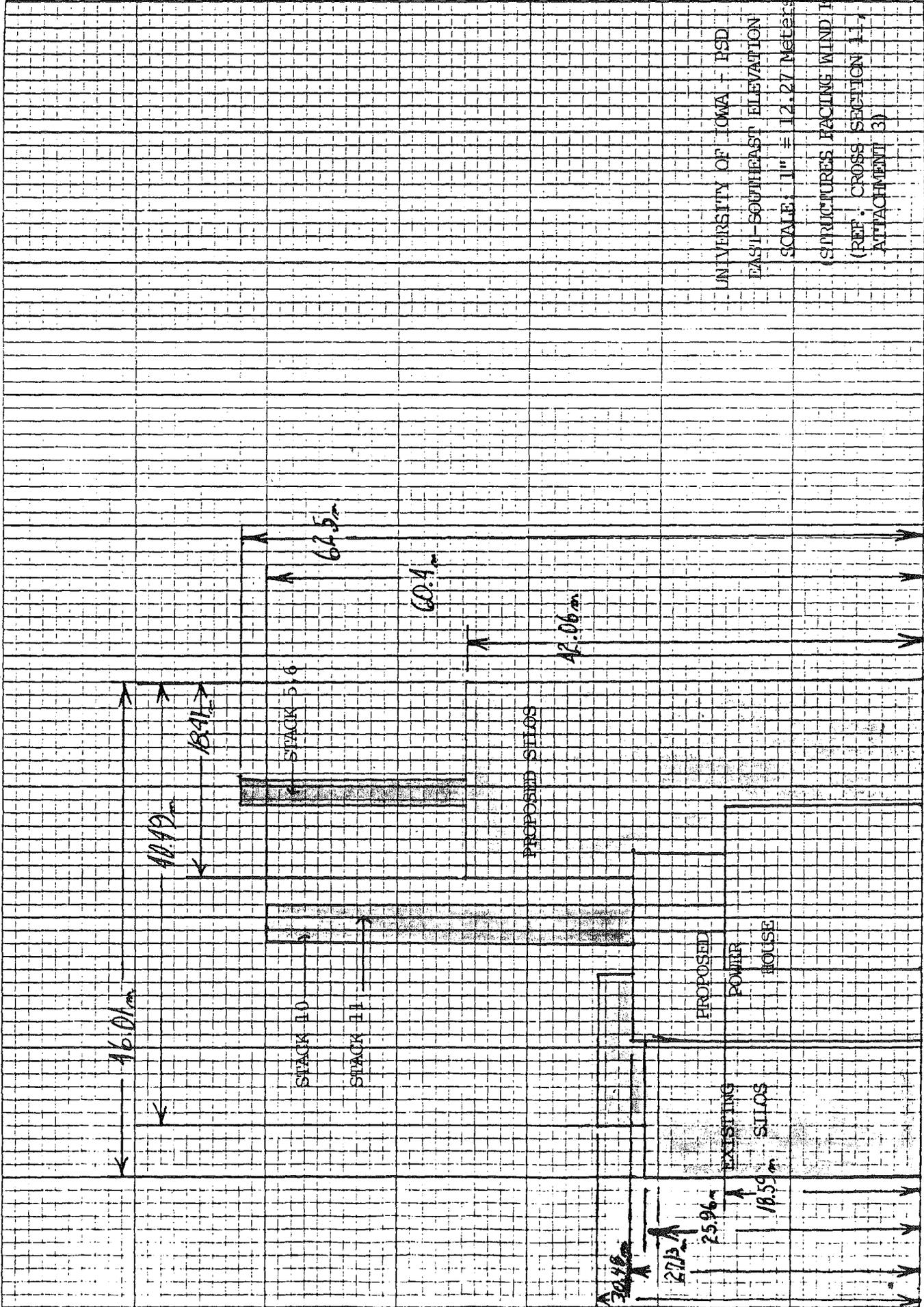
NOTES:
THIS DRAWING SHOWS WORK WITHOUT RESPECT TO CONTRACTS.

1" ≈ 40.25'; 12.27 m.



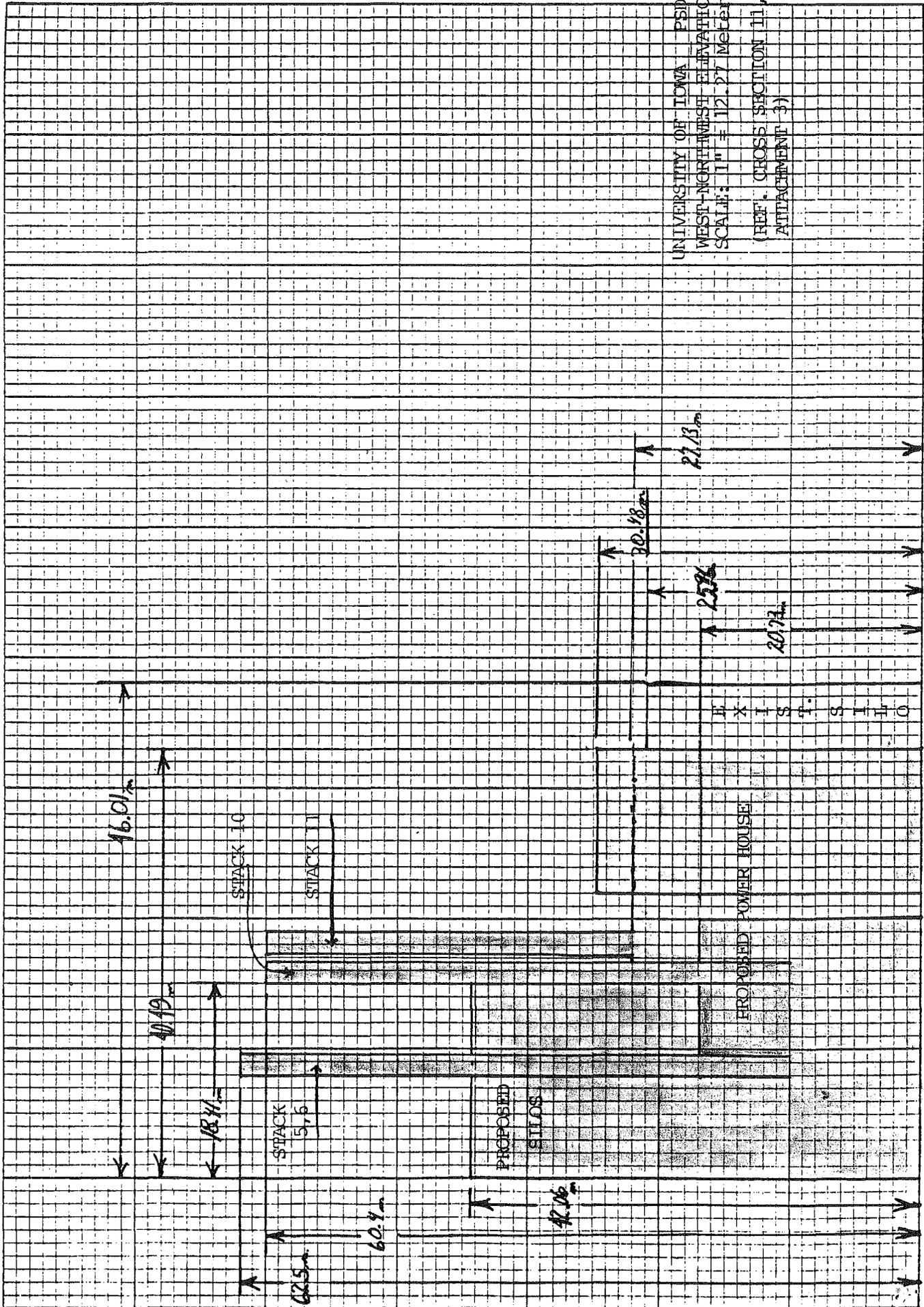
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PLANT LAYOUT KEY PI



UNIVERSITY OF IOWA - PSD
 EAST-SOUTHEAST ELEVATION
 SCALE: 1" = 12.27 METERS
 (STRUCTURES FACING WIND FLOW)
 (REF. CROSS SECTION 1,
 ATTACHMENT 3)

1/20/87



UNIVERSITY OF IOWA - PSD
 WEST-NORTHWEST ELEVATION
 SCALE: 1" = 12.27 METERS
 (REF. CROSS SECTION II,
 ATTACHMENT 3)

Archer