



Department of Alternative  
Energy Development and Efficiency  
MINISTRY OF ENERGY

# HUAI LAM SIN HYDROPOWER PROJECT

## AMPHOE KONGRA CHANGWAT PHATTHALUNG

### CONTRACT C2

### ELECTRO – MECHANICAL EQUIPMENT

### VOLUME 4 DRAWINGS

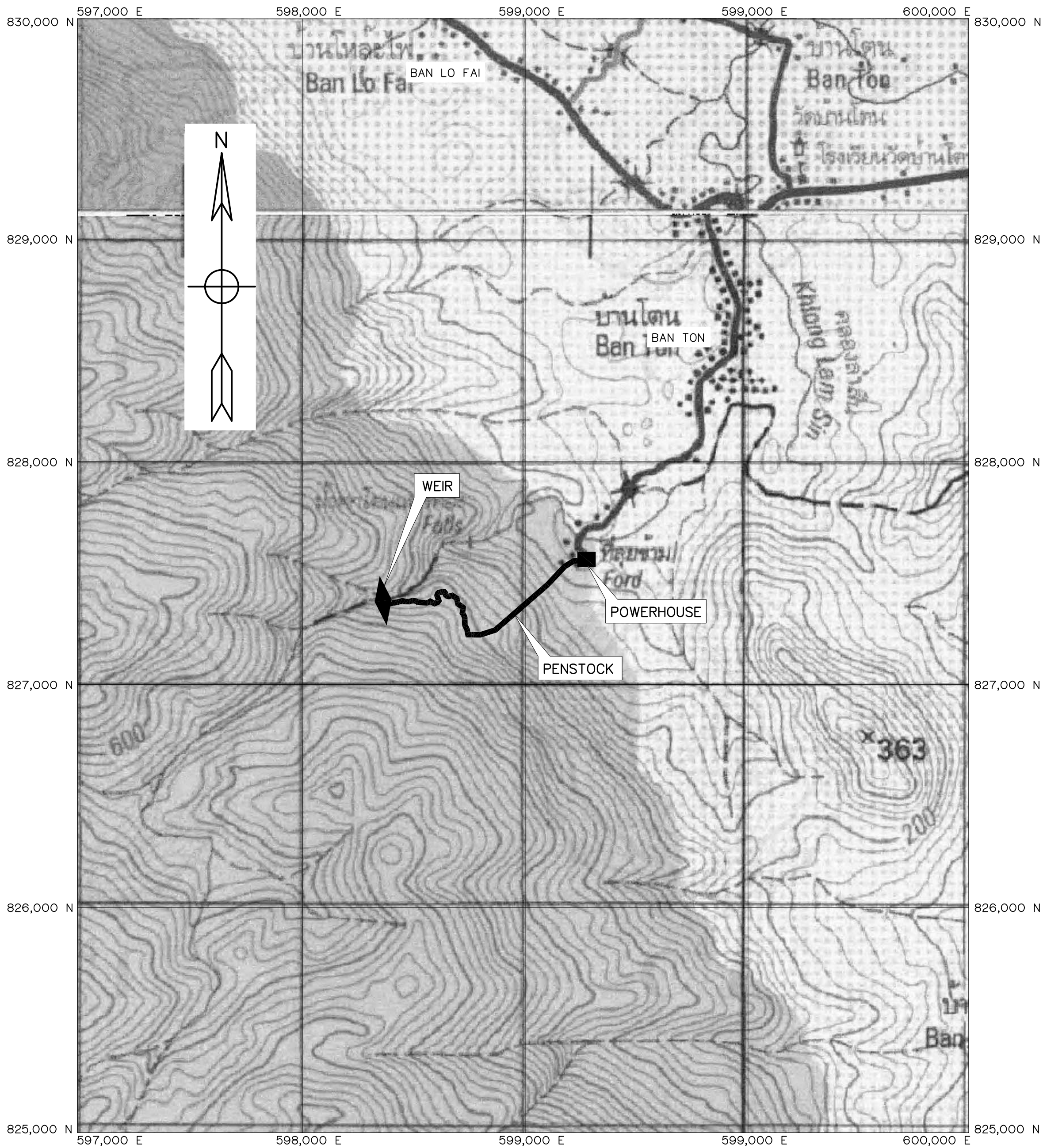


FRONTIER ENGINEERING CONSULTANTS CO.,LTD.

HUAI LAM SIN HYDROPOWER PROJECT  
CONTRACT C2 : LIST OF DRAWINGS

| SHEET NO.        | DRAWING NO. | DRAWING DETAILS                               |
|------------------|-------------|-----------------------------------------------|
| GENERAL          |             |                                               |
| 1                | HLS-GN-01   | LOCATION MAP AND PROJECT AREA MAP             |
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|                  |             |                                               |
| INTAKE STRUCTURE |             |                                               |
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| 7                | HLS-IS-02   | PLAN AND SECTION A-A                          |
| 8                | HLS-IS-03   | SECTION B-B, C-C, D-D AND E-E                 |
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|                  |             |                                               |
| PENSTOCK         |             |                                               |
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| 10               | HLS-PS-02   | PLAN AND PROFILE, STA. 0+400 TO STA. 0+800    |
| 11               | HLS-PS-03   | PLAN AND PROFILE, STA. 0+800 TO STA. 1+000    |
| 12               | HLS-PS-04   | PLAN AND PROFILE, STA. 1+000 TO STA. 1+171.00 |
|                  |             |                                               |
|                  |             |                                               |

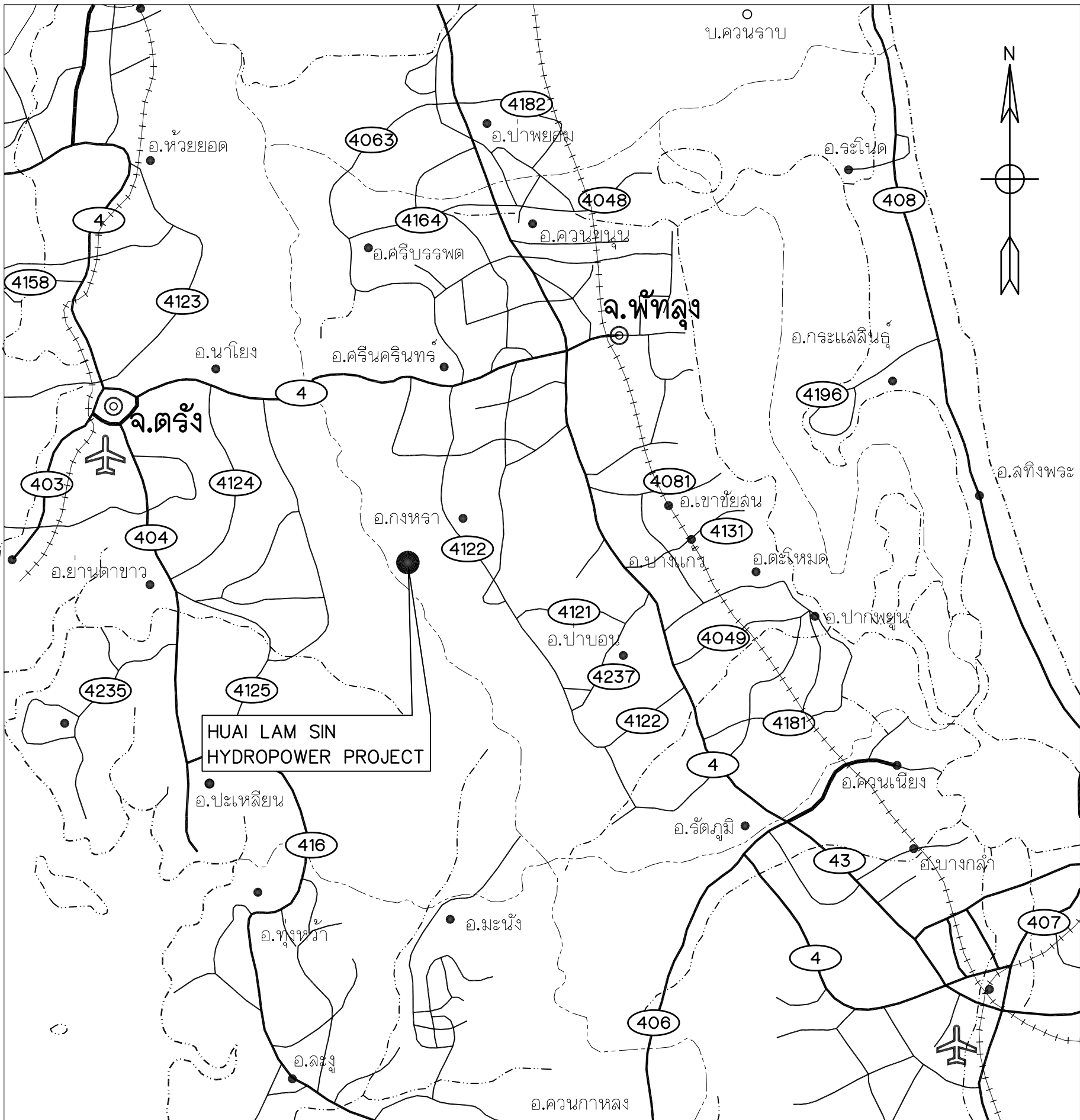
| SHEET NO.                      | DRAWING NO. | DRAWING DETAILS                              |
|--------------------------------|-------------|----------------------------------------------|
| POWER HOUSE                    |             |                                              |
| 13                             | HLS-PH-01   | GENERAL LAY-OUT                              |
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| 19                             | HLS-PH-07   | TRANSFORMER AND SWITCHYARD, DETAILS          |
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|                                |             |                                              |
| ELECTRO – MECHANICAL EQUIPMENT |             |                                              |
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|                                |             |                                              |
|                                |             |                                              |



PROJECT AREA MAP  
SCALE 1:15,000

LEGENDS :

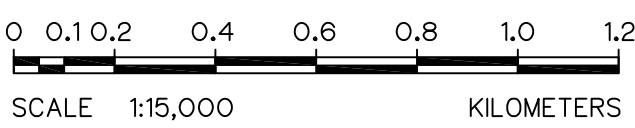
- STREAM
- WEIR
- PENSTOCK
- POWERHOUSE



LOCATION MAP  
NOT TO SCALE

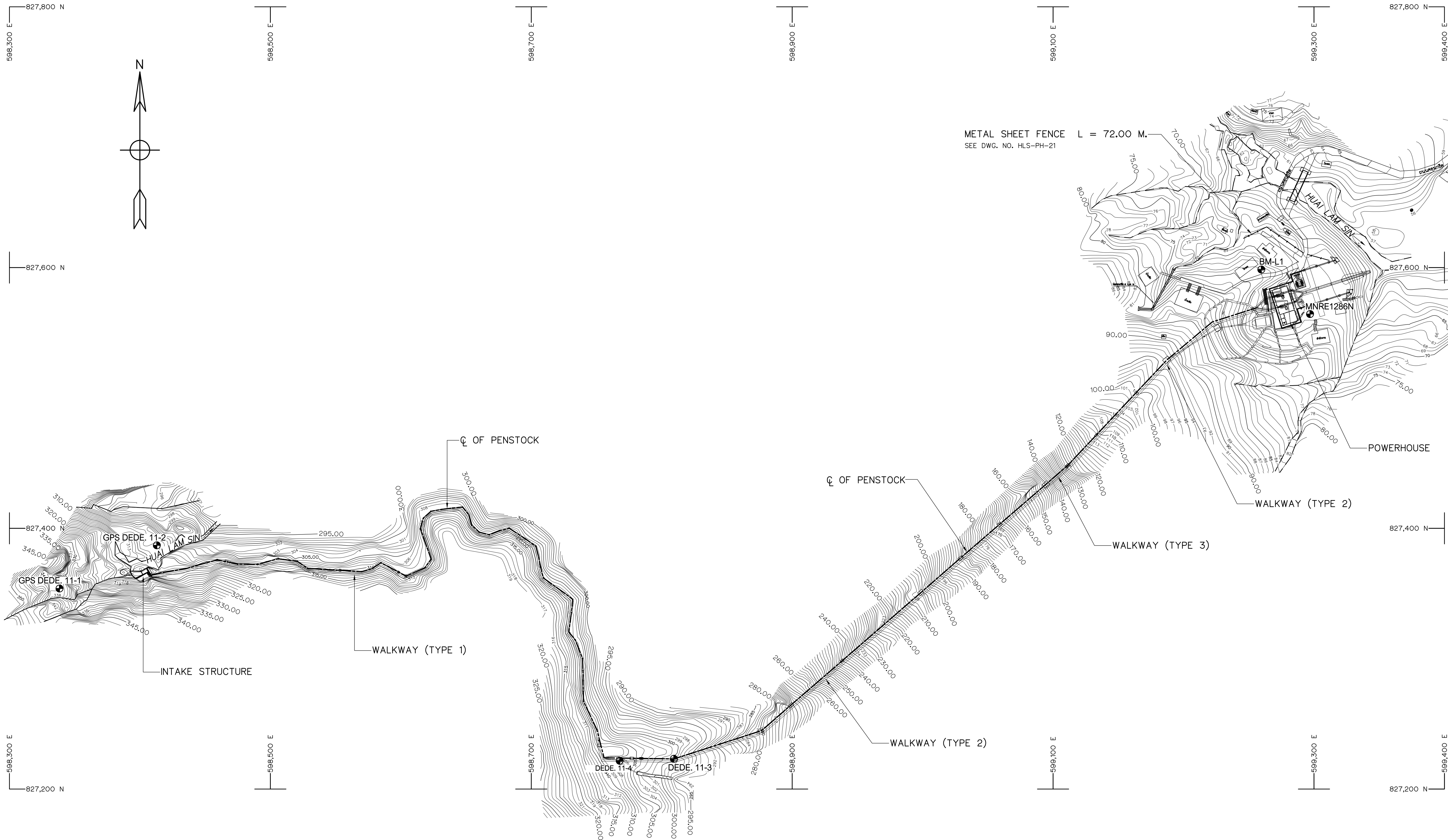
NOTES :

- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN
- SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03



|             |      |           |         |          |
|-------------|------|-----------|---------|----------|
| 3           |      |           |         |          |
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| NO.         | DATE | REVISIONS | CHECKED | APPROVED |
| CONSULTANTS |      |           | DEDE    |          |

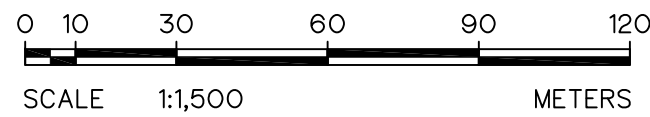
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|-------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------|--------------------------|
| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |  |                                                                                      |                          |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                             |  |                                                                                      |                          |
| CIVIL WORKS<br>GENERAL<br>LOCATION MAP AND PROJECT AREA MAP                                                 |  |                                                                                      |                          |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   |  | Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                          |
| DESIGNED                                                                                                    |  | SUBMITTED                                                                            |                          |
| DRAWN                                                                                                       |  | RECOMMENDED                                                                          |                          |
| CHECKED                                                                                                     |  | APPROVED                                                                             |                          |
| PROJECT MANAGER                                                                                             |  | 14/01/62<br>DATE                                                                     | DRAWING NO.<br>HLS-GN-01 |
|                                                                                                             |  |                                                                                      | SHEET NO.<br>1 OF 25     |



| BM. DESCRIPTIONS |             |             |                        |
|------------------|-------------|-------------|------------------------|
| BM NO.           | COORDINATE  |             | ELEVATION<br>M. (MSL.) |
|                  | N           | E           |                        |
| GPS DEDE. 11-1   | 827,354.129 | 598,338.669 | +339.199               |
| GPS DEDE. 11-2   | 827,387.233 | 598,413.286 | +308.463               |
| DEDE. 11-3       | 827,223.464 | 598,809.441 | +301.019               |
| DEDE. 11-4       | 827,221.905 | 598,767.983 | +307.643               |
| BM-L1            | 827,598.487 | 599,259.619 | +73.947                |
| MNRE1286N        | 827,564.329 | 599,296.961 | +68.789                |

PROJECT MAP  
SCALE 1:1,500

- NOTES :
- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS. UNLESS OTHERWISE SHOWN.
  - SYMBOLE, ABBREVIATIONS AND CENERAL NOTES SEE DWG. NO. HLS-GN-03



|     |      |             |         |          |
|-----|------|-------------|---------|----------|
| 3   |      |             |         |          |
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| NO. | DATE | REVISIONS   | CHECKED | APPROVED |
|     |      | CONSULTANTS | DEDE    |          |

|                                                                                                                                                                                                                           |                                  |                                                                                      |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------|--|
| <div><div>KINGDOM OF THAILAND<br/>Department of Alternative<br/>Energy Development and Efficiency<br/>MINISTRY OF ENERGY</div></div> | HUA I LAM SIN HYDROPOWER PROJECT |                                                                                      |  |
| CIVIL WORKS<br>GENERAL<br>PROJECT MAP                                                                                                                                                                                     |                                  |                                                                                      |  |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                                                                                                                                 |                                  | Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |  |
| DESIGNED                                                                                                                                                                                                                  |                                  | REVIEWED S.KTICHAJ                                                                   |  |
| DRAWN                                                                                                                                                                                                                     |                                  | SUBMITTED                                                                            |  |
| CHECKED                                                                                                                                                                                                                   |                                  | RECOMMENDED                                                                          |  |
| APPROVED                                                                                                                                                                                                                  |                                  | APPROVED                                                                             |  |
| PROJECT MANAGER                                                                                                                                                                                                           |                                  | DRAWING NO.<br>HLS-GN-02                                                             |  |
| DATE<br>14/01/62                                                                                                                                                                                                          |                                  | SHEET NO.<br>2 OF 25                                                                 |  |

ABBREVIATIONS :

|                                    |                                  |            |                                   |
|------------------------------------|----------------------------------|------------|-----------------------------------|
| A                                  | CROSS-SECTION AREA OF FLOW       | MAX.       | MAXIMUM                           |
| AC.                                | ASBESTOS CEMENT PIPE             | M.S.L.     | MEAN SEA LEVEL                    |
| AGG.                               | AGGREGATE                        | MISC.      | MISCELLANEOUS                     |
| ALT.                               | ALTERNATIVE                      | N.         | NORTH                             |
| APPROX.                            | APPROXIMATE                      | n.         | MANNING'S ROUGHNESS COEFFICIENT   |
| AZ.                                | AZIMUTH                          | N.F.       | NEAR FACE                         |
| B.                                 | BEGINNING OF SURVEY              | NGL.       | NATURAL GROUND LEVEL              |
| BC.                                | BEGINNING OF CURVE               | NO. OR #   | NUMBER                            |
| BEG.                               | BEGINNING                        | N.W.L.     | NORMAL WATER LEVEL                |
| BF.                                | BOTTOM FACE                      | OD.        | OUTSIDE DIAMETER                  |
| B                                  | BEAM                             | O.F.       | OUTSIDE FACE                      |
| B.M.                               | BENCH MARK                       | O&M        | OPERATION & MAINTENANCE           |
| BOTT.                              | BOTTOM                           | PC.        | POINT OF HONRIZONTAL CURVATURE    |
| BRG.                               | BEARING                          | PI.        | POINT OF HORIZONTAL INTERSECTION  |
| C.B.R.                             | CALIFORNIA BEARING RATIO         | PL.        | PLATE                             |
| C/C                                | CENTER TO CENTER                 | P.O.C.     | POINT ON CURVE                    |
| ☒                                  | CENTER LINE                      | P.O.T.     | POINT ON TANGENT                  |
| CL.                                | CLEARANCE                        | P.O.S.T.   | POINT ON SUB-TANGENT              |
| CM. OR cm.                         | CENTIMETER                       | PRC.       | POINT OF HORIZONTAL REVERSE CURVE |
| CM./S OR cm./s                     | CENTIMETER PER SECOND            | PT.        | POINT OF TANGENT                  |
| COL.                               | COLUMN                           | PVC.       | POLYVINYL CHLORIDE                |
| CONC.                              | CONCRETE                         | PVC.       | POINT OF VERTICAL CURVATURE       |
| D                                  | DEGREE OF CURVE                  | PVI.       | POINT OF VERTICAL INTERSECTION    |
| DB.                                | DEFORM BAR                       | PVRC.      | POINT OF VERTICAL REVERSE CURVE   |
| d.                                 | DEPTH OF WATER                   | PVT.       | POINT OF VERTICAL TANGENT         |
| DIA. OR Ø                          | DIAMETER                         | Q.         | DISCHARGE                         |
| DOH.                               | DEPARTMENT OF HIGHWAY            | QTY. QUAN. | QUANTITY                          |
| DWG.                               | DRAWING                          | R          | RADIUS OF CURVATURE               |
| DEDE.                              | DEPARTMENT OF ALTERNATIVE ENERGY | r          | HYDRAULIC RADIUS                  |
|                                    | DEVELOPMENT AND EFFICIENCY       | ∅ , Ø      | ROUND BAR                         |
| E                                  | EAST                             | RC.        | REINFORCED CONCRETE               |
| E                                  | END OF SURVEY                    | RD.        | ROAD                              |
| EA.                                | EACH                             | REF.       | REFERENCE                         |
| E.C.                               | END OF CURVE                     | REINF.     | REINFORCEMENT                     |
| E.F.                               | END OF FACE                      | REQ'D      | REQUIRED                          |
| EL. OR ELEV.                       | ELEVATION                        | RID.       | ROYAL IRRIGATION DEPARTMENT       |
| EXIST.                             | EXISTING                         | SCH.       | SCHEDULE                          |
| EXP.                               | EXPANSION                        | SE.        | SUPERELEVATION                    |
| EXT.                               | EXTERIOR                         | SETC.      | SECTION                           |
| EX.                                | EXTERNAL DISTANCE OF CURVE       | S.P.C.T.   | STANDARD PROCTOR COMPACTION TEST  |
| f                                  | FREE BOARD , FINISH              | S.S.       | SIDE SLOPE                        |
| F.F.                               | FAR FACE                         | STIR.      | STIRRUP                           |
| F.S.L.                             | FULL SUPPLY LEVEL                | STA.       | STATION                           |
| FTG.                               | FOOTING                          | STD.       | STANDARD                          |
| HD.                                | HEAD                             | STR.       | STRUCTURE                         |
| HEX.                               | HEXAGONAL                        | SYMM.      | SYMMETRICAL                       |
| HOR.                               | HORIZONTAL                       | T.         | TANGENT LENGTH , THICKNESS        |
| I.D.                               | INSIDE DIAMETER                  | T          | TON                               |
| I.F.                               | INSIDE FACE                      | THK.       | THICKNESS                         |
| IN. OR "                           | INCH                             | T.F.       | TOP FACE                          |
| INT.                               | INTERIOR                         | T.I.S.     | THAI INDUSTRIAL STANDARD          |
| INV.                               | INVERT                           | Ts.        | SUPERELEVATION TRANSITION LENGTH  |
| Kg.                                | KILOGRAM                         | TYP.       | TYPICAL                           |
| Km.                                | KILOMETER                        | V.         | VELOCITY OF FLOW                  |
| KPH.                               | KILOMETER PER HOUR               | V.C.       | VERTICAL CURVE                    |
| KSC.                               | KILOGRAM PER SQUARE CENTIMETER   | Vc.        | LENGTH OF VERTICAL CURVE          |
| L                                  | LENGTH OF CURVE                  | VER.       | VERTICAL                          |
| LC.                                | LENGTH OF HORIZONTAL CURVE       | VOL.       | VOLUME                            |
| LONG.                              | LONGITUDINAL                     | W/         | WITH                              |
| LT.                                | LEFT                             | W.C.       | WATER CLOSET                      |
| L.W.L.                             | LOW WATER LEVEL                  | ⊙          | ANGLE                             |
| M. OR m.                           | METER                            | △          | DEFLECTION ANGLE                  |
| M. <sup>2</sup> OR m. <sup>2</sup> | SQUARE METER                     |            |                                   |
| M. <sup>3</sup> OR m. <sup>3</sup> | CUBIC METER                      |            |                                   |
| MM. OR mm.                         | MILLIMETER                       |            |                                   |
| M./S OR m./s                       | METER PER SECOND                 |            |                                   |
| MIN.                               | MINIMUM                          |            |                                   |

SYMBOLS :

|  |                                            |
|--|--------------------------------------------|
|  | TYPICAL NORTH ARROW                        |
|  | CENTER LINE                                |
|  | PAVED ROAD                                 |
|  | DIRT ROAD, LATEITE ROAD OR TRACK           |
|  | VILLAGE                                    |
|  | CITY OR DISTRICT                           |
|  | POND OR SWAMP                              |
|  | CULVERT UNDER ROAD                         |
|  | BRIDGE                                     |
|  | POLE                                       |
|  | TEST PIT                                   |
|  | EXISTING HAND AUGER                        |
|  | EXISTING DRILL HOLES                       |
|  | DRILL HOLES                                |
|  | DEGREE, MINUTE, SECOND                     |
|  | AT EQUAL DISTANCE BETWEEN CENTER TO CENTER |
|  | B.M.                                       |
|  | STATION                                    |
|  | BC., EC., PC., PI., PT., PCV., PVT.        |
|  | WATER LEVEL                                |
|  | PLAN OF RIPRAP                             |
|  | PLAN OF SLOPE RIPRAP                       |
|  | SECTION OF DUMPED RIPRAP                   |
|  | SECTION OF HAND PLACED RIPRAP              |
|  | SECTION OF SAND                            |
|  | SECTION OF GRAVEL OR COARSE AGGREGATE      |
|  | SECTION OF ROCK                            |
|  | SECTION OF EARTH                           |
|  | SECTION OF BACKFILL                        |
|  | SECTION OF CONCRETE                        |
|  | STEEL SECTION                              |
|  | ELEVATION OR PLAN OF EARTH CUT OR FILL     |
|  | ELEVATION OR PLAN OF ROCK CUT              |
|  | ELEVATION OR PLAN OF SLOPE                 |
|  | NATURAL GROUND LEVEL                       |
|  | CONTOUR LINE                               |
|  | RIVER, STREAM OR NATURAL DRAIN             |
|  | FLOW DIRECTION                             |
|  | SLOPE DIRECTION                            |
|  | SLOPE RATIO                                |

GENERAL NOTES :

- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS UNLESS OTHERWISE SHOWN.
- DURING THE CONTRUCTION PERIOD, IT IS THE CONTRACTOR'S DUTY TO CHECK THE CORRECTION OF ALL RELEVANT LOCATIONS, DIMENSIONS, ELEVATIONS AND OTHER DATA AS PROVIDED BY THE DRAWING AND TECHNICAL SPECIFICATIONS BEFORE THE IMPLEMENTATION OF THE WORKS.
- IN CASE OF ANY DETAILS BEING NOT MENTIONED OR NOT SHOWN IN THE DRAWING OR TECHNICAL SPECIFICATIONS, OR IN CASE OF ANY DISCREPANCY, DEFECTIVE DESCRIPTION, ERROR, DIMENSION OR AMBIGUTY BETWEEN OR IN ANY OF THE DRAWINGS, IT IS THE CONTRACTOR'S RESPONSIBILITY TO CORRECT AND/OR ADJUST THE RELEVENT DRAWINGS TO OBTAIN FIELD ENGINEER APPROVAL
- ADDITIONAL SYMBOLS, IF REQUIRED, ARE DEFINED IN THE RESPECTIVE DRAWINGS.
- THE SPECIFICATIONS AND THE QUANTITIES OF MATERIALS ARE SPECIFIED IN THE TECHNICAL SPECIFICATIONS.
- ALL PLAIN CONCRETE CORNERS ARE TO BE CHEMFERED 2 cm. UNLESS OTHERWISE SHOWN.
- SLOPE IN CUT AND FILL SECTIONS, UNLESS OTHERWISE SHOWN, SHALL BE CONFORMED TO THE FOLLOWING TABLE OR AS DIRECTED BY FIELD ENGINEER.

| EXISTING GROUND SLOPE<br>1:S | EARTH                    |               | HARD ROCK |               |
|------------------------------|--------------------------|---------------|-----------|---------------|
|                              | CUT 1:S                  | FILL 1:S      | CUT 1:S   | FILL 1:S      |
| OVER 1:1                     | OVER 1:0.5 $\frac{2}{1}$ | $\frac{1}{1}$ | 1:0       | $\frac{1}{1}$ |
| 1:1 – 1:1.5                  | 1:0.5                    | 1             | 1:0       | $\frac{1}{1}$ |
| 1:1.5 – 1:2                  | 1:1                      | 1:1           | 1:0       | 1:1           |
| 1:2 – 1:3                    | 1:1                      | 1:1.5         | 1:0       | 1:1.5         |
| LOWER 1:3                    | 1:1                      | 1:2           | 1:0       | 1:2           |

$\frac{2}{1}$  = FILL SHOULD BE AVOIDED

$\frac{1}{1}$  = FOR DOUBTFUL CASES CONSULT FIELD ENGINEER

STRUCTURAL DESIGN NOTES :

- THE ULTIMATE COMPRESSIVE STRENGTH OF CONCRETE OF STANDARD CYLINDER (Ø0.15x0.30 m.) TEST AT AGE 28 DAYS SHALL BE AS THE FOLLOWING, UNLESS OTHERWISE SHOWN.

| fc' (ksc) | DESCRIPTION                   |
|-----------|-------------------------------|
| 350       | PRESTRESS CONCRETE            |
| 210       | 1. WEIR / INTAKE STRUCTURE    |
|           | 2. POWERHOUSE, TAILRACE       |
|           | 3. TAILRACE                   |
|           | 4. MANHOLE                    |
|           | 5. ANCHOR BLOCK, PIPE SUPPORT |
|           | 6. BOX CULVERT                |
| 140       | LEAN CONCRETE                 |
|           |                               |

- UNLESS OTHERWISE SHOWN, THE FOLLOWING CLEAR COVER OF CONCRETE OVER OF THE REINFORCEMENT SHALL BE USED :
  - FACE EXPOSED TO SCOUR 5.0 cm.
  - FACE EXPOSED TO EARTH OR WEATHER 5.0 cm.
  - FACE UNEXPOSED TO EARTH OR WEATHER 3.0 cm.
- THE REINFORCEMENT LAP SPLICES SHALL NOT BE LESS THAN 50 DIAMETERS OF BIGGER THAN BAR WITH HOOKS, UNLESS OTHERWISE SHOWN.
- EMBEDDED METALWORK SHALL BE SECURELY FASTENED IN POSITION BEFORE PLACING CONCRETE.
- ALL CONSTRUCTION JOINT SHOULD BE TREATED AS DIRECTED IN ORDER TO ASSURE THE BEST BOND.
- A 5 cm. (MIN.) LAYER OF LEAN CONCRETE (1:3:5 BY VOLUME) SHOULD BE PLACED BELOW CONCRETE STRUCTURES.
- THE STRUCTURES SHOULD BE PLACED ON UNDISTURBED SOILS OR COMPACTED FILL AND BACKFILL AROUND THE STRUCTURES SHOULD BE COMPACTED.
- THE FOUNDATION ELEVATIONS ARE SUBJECT TO CHANGE AS DIRECTED ACCORDING TO THE SOIL CONDITIONS.
- ALL SIZES OF REINFORCING BARS AND STRUCTURAL STEELS ARE IN MILLIMETERS.
- ALL STRUCTURAL STEELS ARE THOSE OF T.I.S. DESIGNATION Fe24.
- REINFORCED STEEL BARS SHALL BE CONFORM TO T.I.S. AS FOLLOW :
  - DEFORMED BARS (SD30) – T.I.S. 24–2559
  - ROUND BARS (SR24) – T.I.S. 20–2559
- ALLOWABLE BEARING CAPACITY OF FOUNDATION

SHALL NOT BE LESS THAN AS FOLLOW :

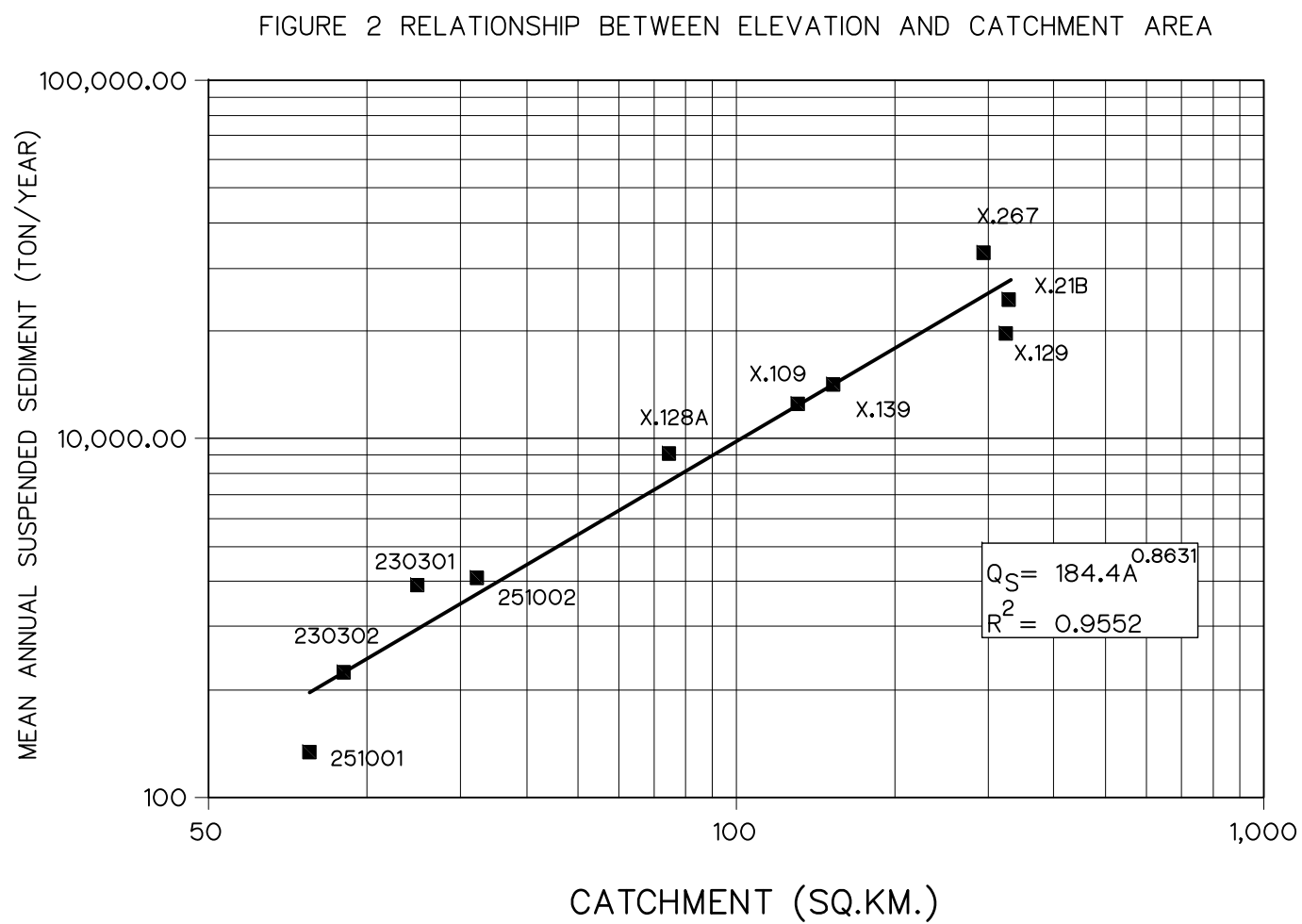
- INTAKE STRUCTURE  $Q_a = 25 \text{ T/M.}^2$
- POWERHOUSE  $Q_a = 10 \text{ T/M.}^2$
- PENSTOCK  $Q_a = 15 \text{ T/M.}^2$
- WALKWAY  $Q_a = 10 \text{ T/M.}^2$

|     |             |           |         |          |
|-----|-------------|-----------|---------|----------|
| 3   |             |           |         |          |
| 2   |             |           |         |          |
| 1   |             |           |         |          |
| NO. | DATE        | REVISIONS | CHECKED | APPROVED |
|     | CONSULTANTS |           | DEDE    |          |

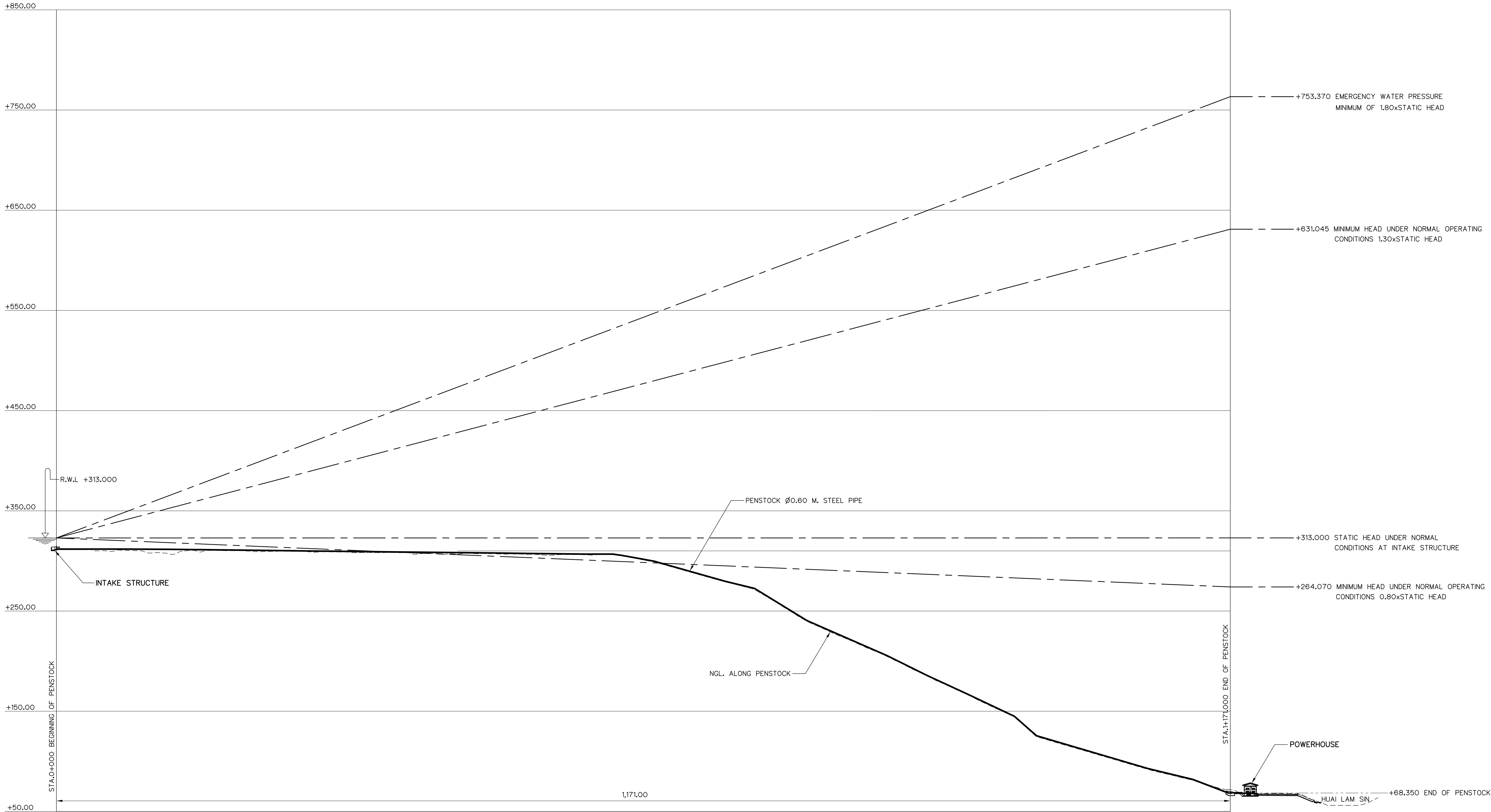
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|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| <br>KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                                                                                          |
| HUA I LAM SIN HYDROPOWER PROJECT                                                                                |                                                                                          |
| CIVIL WORKS<br>GENERAL<br>SYMBOLS, ABBREVIATIONS, AND GENERAL NOTES                                             |                                                                                          |
| <br>FRONTIER ENGINEERING CONSULTANTS CO., LTD.                                                                  | <br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| DESIGNED<br>21.6.651                                                                                            | REVIEWED S.KTICHAJ                                                                       |
| DRAWN                                                                                                           | SUBMITTED                                                                                |
| CHECKED<br>21.7.324                                                                                             | RECOMMENDED                                                                              |
| <br>PROJECT MANAGER                                                                                             | APPROVED                                                                                 |
| 14/01/62<br>DATE                                                                                                | DRAWING NO.<br>HLS–GN–03                                                                 |
|                                                                                                                 | SHEET NO.<br>3 OF 25                                                                     |

|                        |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
|------------------------|------------------|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Station                | KASETPHATTHALUNG | Elevation of station above M.S.L. | 2.00   | Meters |        |        |        |        |        |        |        |        |        |
| Index station          | 48560            |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Latitude               | 7° 35′ 0.0″ N    |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Longitude              | 100° 10′ 0.0″ E  |                                   |        |        |        |        |        |        |        |        |        |        |        |
|                        | JAN              | FEB                               | MAR    | APR    | MAY    | JUN    | JUL    | AUG    | SEP    | OCT    | NOV    | DEC    | ANNUAL |
| Pressure (Hectopascal) |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean                   | 1011.5           | 1010.9                            | 1010.1 | 1009.1 | 1008.4 | 1008.0 | 1008.4 | 1008.7 | 1009.3 | 1009.8 | 1009.6 | 1010.4 | 1009.5 |
| Ext. max.              | 1019.3           | 1018.6                            | 1016.5 | 1015.6 | 1013.7 | 1015.1 | 1013.8 | 1013.7 | 1014.9 | 1015.9 | 1015.7 | 1017.1 | 1019.3 |
| Ext. min.              | 1003.9           | 1004.4                            | 1003.4 | 1002.8 | 1002.6 | 1002.3 | 1003.2 | 1003.6 | 1004.1 | 1003.4 | 1001.6 | 1004.0 | 1001.6 |
| Mean daily range       | 3.6              | 3.8                               | 4.2    | 4.2    | 3.8    | 3.4    | 3.4    | 3.7    | 4.0    | 4.1    | 3.9    | 3.7    | 3.8    |
| Temperature (Celsius)  |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean                   | 26.8             | 27.4                              | 28.1   | 28.7   | 28.5   | 28.3   | 27.9   | 27.9   | 27.6   | 27.2   | 26.8   | 26.6   | 27.7   |
| Mean max.              | 30.4             | 31.6                              | 32.6   | 33.6   | 33.9   | 33.5   | 33.3   | 33.3   | 32.9   | 31.9   | 30.3   | 29.8   | 32.3   |
| Mean min.              | 23.7             | 23.6                              | 24.2   | 25.0   | 25.0   | 24.6   | 24.4   | 24.3   | 24.3   | 24.2   | 24.4   | 24.2   | 24.3   |
| Ext. max.              | 32.6             | 34.5                              | 35.6   | 37.0   | 37.3   | 36.5   | 36.7   | 37.7   | 36.6   | 36.1   | 34.4   | 32.8   | 37.7   |
| Ext. min.              | 20.3             | 18.5                              | 20.3   | 23.0   | 23.0   | 22.5   | 22.0   | 21.9   | 22.5   | 21.2   | 19.8   | 21.8   | 18.5   |
| Dew Point (Celsius)    |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean                   | 23.7             | 23.5                              | 24.2   | 24.8   | 24.7   | 24.2   | 23.8   | 23.7   | 23.8   | 24.1   | 24.4   | 24.2   | 24.1   |
| Relative Humidity (%)  |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean                   | 84               | 80                                | 80     | 81     | 81     | 80     | 80     | 80     | 81     | 84     | 88     | 87     | 82     |
| Mean max.              | 94               | 93                                | 93     | 94     | 94     | 94     | 94     | 94     | 94     | 95     | 96     | 95     | 94     |
| Mean min.              | 72               | 66                                | 65     | 65     | 63     | 62     | 61     | 60     | 63     | 68     | 76     | 77     | 66     |
| Ext. min.              | 55               | 47                                | 49     | 47     | 44     | 42     | 38     | 34     | 40     | 43     | 52     | 61     | 34     |
| Visibility (km.)       |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| 07.00 LST              | 8.5              | 9.0                               | 9.2    | 9.2    | 9.1    | 9.0    | 8.9    | 9.1    | 8.8    | 8.5    | 7.9    | 8.1    | 8.8    |
| Cloudiness (0–10)      |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean                   | 6.3              | 4.7                               | 5.1    | 5.7    | 6.6    | 6.8    | 7.2    | 6.8    | 7.2    | 7.4    | 7.3    | 7.1    | 6.5    |
| Wind (knots)           |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean wind speed        | 1.9              | 2.1                               | 2.0    | 1.9    | 1.8    | 2.1    | 2.3    | 2.4    | 2.5    | 1.9    | 1.4    | 1.7    | 2.0    |
| Max. wind speed        | 21               | 20                                | 25     | 25     | 30     | 25     | 30     | 30     | 32     | 31     | 40     | 22     | 40     |
| Evaporation (mm.)      |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean–pan               | 87.6             | 105.0                             | 120.1  | 120.3  | 122.7  | 116.0  | 121.9  | 125.2  | 108.5  | 93.6   | 69.3   | 71.2   | 1261.4 |
| Rainfall (mm.)         |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Mean                   | 119.6            | 70.5                              | 118.7  | 113.0  | 103.7  | 80.6   | 80.4   | 98.5   | 115.7  | 250.5  | 549.3  | 448.2  | 2148.7 |
| Mean rainy day         | 12               | 5                                 | 7      | 10     | 13     | 10     | 12     | 13     | 14     | 20     | 22     | 21     | 158    |
| Daily maximum          | 176.1            | 312.8                             | 199.1  | 128.2  | 120.3  | 68.2   | 76.2   | 134.4  | 84.5   | 111.6  | 312.7  | 253.8  | 312.8  |
| Number of days with    |                  |                                   |        |        |        |        |        |        |        |        |        |        |        |
| Haze                   | 1                | 0                                 | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1      | 0      | 0      | 3      |
| Fog                    | 1                | 3                                 | 3      | 4      | 4      | 7      | 6      | 5      | 6      | 2      | 1      | 0      | 41     |
| Hail                   | 0                | 0                                 | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Thunderstorm           | 1                | 1                                 | 4      | 7      | 10     | 6      | 5      | 6      | 6      | 8      | 8      | 3      | 66     |
| Squall                 | 0                | 0                                 | 0      | 1      | 1      | 1      |        |        |        |        |        |        |        |

| RETURN PERIOD<br>(YEAR) | FLOOD PEAK DISCHARGE (M. <sup>3</sup> /SEC.) |                 |
|-------------------------|----------------------------------------------|-----------------|
|                         | REGIONAL FLOOD<br>FREQUENCY ANALYSIS         | UNIT HYDROGRAPH |
| 10                      | 70.6                                         | 58.8            |
| 25                      | 90.5                                         | 81.5            |
| 50                      | 105.3                                        | 100.6           |
| 100                     | 119.9                                        | 121.6           |
| 200                     | 134.5                                        | 144.4           |
| 500                     | 153.8                                        | 177.5           |
| 1,000                   | 168.3                                        | 204.6           |



|             |      |           |         |          |                 |          |                      |            |
|-------------|------|-----------|---------|----------|-----------------|----------|----------------------|------------|
| 3           |      |           |         |          | DESIGNED        | 28.6.651 | REVIEWED             | 3.8.21(14) |
| 2           |      |           |         |          | DRAWN           |          | SUBMITTED            |            |
| 1           |      |           |         |          | CHECKED         | 28.7.324 | RECOMMENDED          |            |
| NO.         | DATE | REVISIONS | CHECKED | APPROVED | CHECKED         | 28.7.324 | APPROVED             |            |
| CONSULTANTS |      |           |         |          | DEDE            |          | DRAWING NO. 14/01/62 |            |
|             |      |           |         |          | PROJECT MANAGER |          | SHEET NO. 4 OF 25    |            |



NOTES :

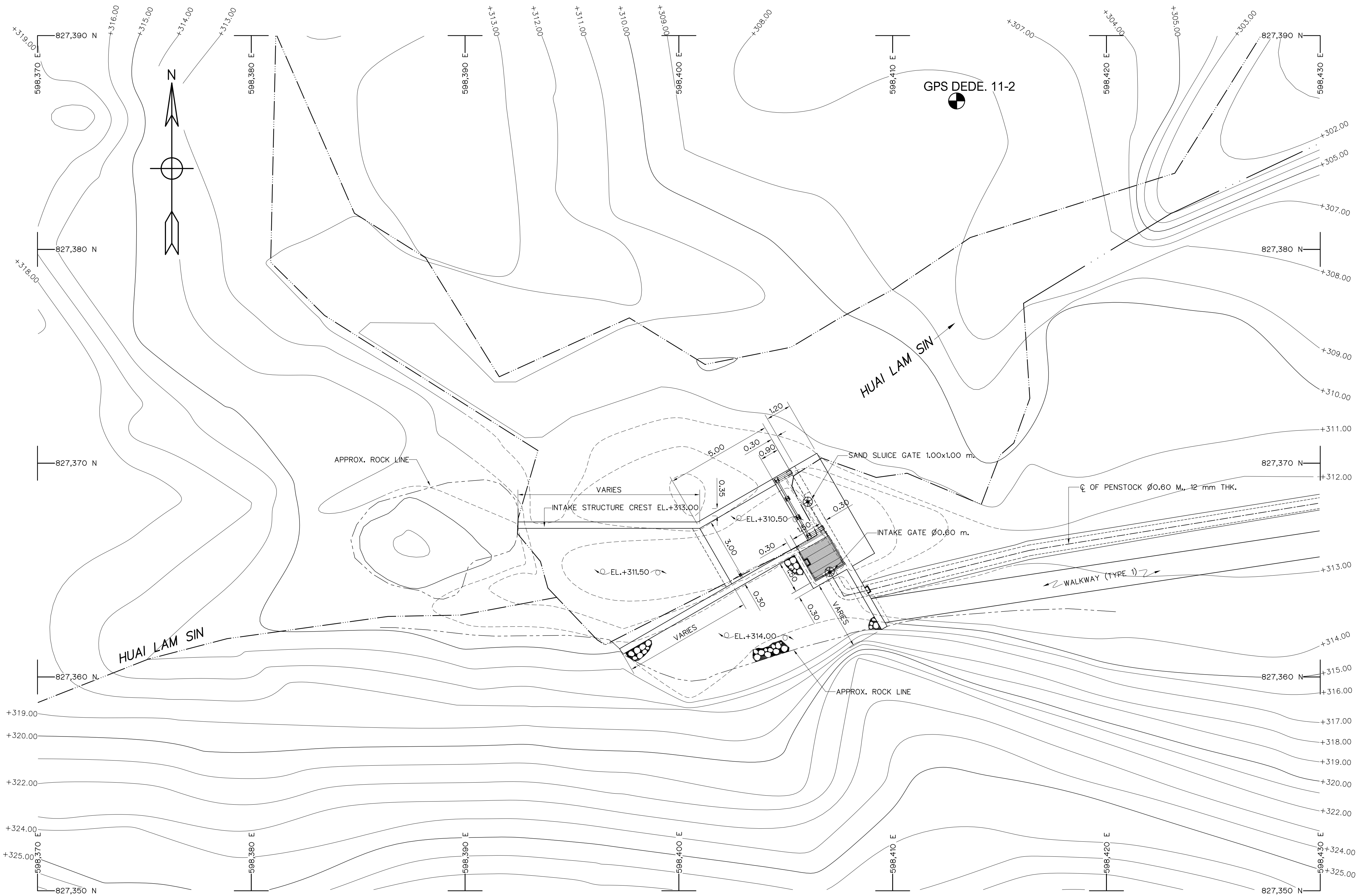
1. THE DATA SHOWN ON THIS DRAWING IS PROVISIONAL AND WILL BE REVIEWED WHEN THE ACTUAL TURBINE CHARACTERISTICS ARE KNOWN.
2. IT HAS BEEN ASSUMED THAT STEEL FOR THE PRESSURE PIPELINE CONFORMS TO STEEL TYPE SS41 OF THE JAPANESE INDUSTRIAL STANDARD JIS G 3101
3. THE THICKNESS OF THE PIPE SHELL SHALL INCLUDE A TOLERANCE OF 2 MM. FOR CORROSION AND SHALL BE DESIGNED FOR THE LOAD CASES SHOWN IN THE TABLE BELOW
4. WELD EFFICIENCY ON THE PRESSURE PIPELINE SHALL BE AT LEAST 90%
5. THE LOADING CASES MAY BE MORE FULLY DEFINED AS BELOW
  - NORMAL - INCLUDES NORMAL WATER PRESSURE AND NORMAL LONGITUDINAL LOADS SUCH AS WEIGHT OF PIPELINE, ANCHOR BLOCK, EXTERNAL SOIL AND WATER PRESSURE
  - EMERGENCY - INCLUDES LOSS OF A SUPPORT OR LOADING DUE TO TEST PRESSURE OR IMPOSITION OF DESIGN EARTHQUAKE ON NORMAL CASE
  - EXTREME - INCLUDES EXTREME WATER PRESSURES IN PIPELINE OR INCIDENCE OF MAXIMUM CREDIBLE EARTHQUAKE PLUS NORMAL WATER PRESSURE
6. THICKNESS OF PENSTOCK DESIGNED BASE ON PRESSURE RISE HEAD (WATER HAMMER) TURBINE PERFORMANCE, CLOSING TIME (6 SECONDS APPROXIMATELY) WILL BE SPECIFIED IN THE BIDDING DOCUMENTS.

| PROFILE ALONG PENSTOCK Q                                                 |                             |
|--------------------------------------------------------------------------|-----------------------------|
| SCALE { VERTICAL 1 : 2,000<br>HORIZONTAL 1 : 2,000                       |                             |
| LOAD CASES                                                               | ALLOWABLE TENSILE STRESS    |
| EXTREME WATER PRESSURE RESULTING FROM SLOWDEN CLOSURE OF THE TABLE VALVE | 1.00 x MINIMUM YIELD STRESS |
| EMERGENCY WATER PRESSURE AND ALL OTHER NORMAL LONGITUDINAL LOADS         | 0.75 x MINIMUM YIELD STRESS |
| NORMAL WATER PRESSURE AND ALL OTHER NORMAL LONGITUDINAL LOADS            | 0.60 x MINIMUM YIELD STRESS |



|             |      |           |         |          |
|-------------|------|-----------|---------|----------|
| 3           |      |           |         |          |
| 2           |      |           |         |          |
| 1           |      |           |         |          |
| NO.         | DATE | REVISIONS | CHECKED | APPROVED |
|             |      |           |         |          |
| CONSULTANTS |      |           | DEDE    |          |

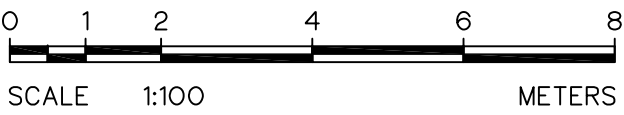
|                                                                                                             |  |                                                                                      |  |
|-------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------|--|
| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |  |                                                                                      |  |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                             |  |                                                                                      |  |
| CIVIL WORKS<br>GENERAL<br>HYDRAULIC GRADE LINE                                                              |  |                                                                                      |  |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   |  | Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |  |
| DESIGNED                                                                                                    |  | REVIEWED S.KITICHAJ                                                                  |  |
| DRAWN                                                                                                       |  | SUBMITTED                                                                            |  |
| CHECKED                                                                                                     |  | RECOMMENDED                                                                          |  |
| PROJECT MANAGER                                                                                             |  | APPROVED                                                                             |  |
| 14/01/62                                                                                                    |  | DRAWING NO.                                                                          |  |
| DATE                                                                                                        |  | HLS-GN-05                                                                            |  |
|                                                                                                             |  | SHEET NO.                                                                            |  |
|                                                                                                             |  | 5 OF 25                                                                              |  |



GENERAL LAY-OUT  
SCALE 1:100

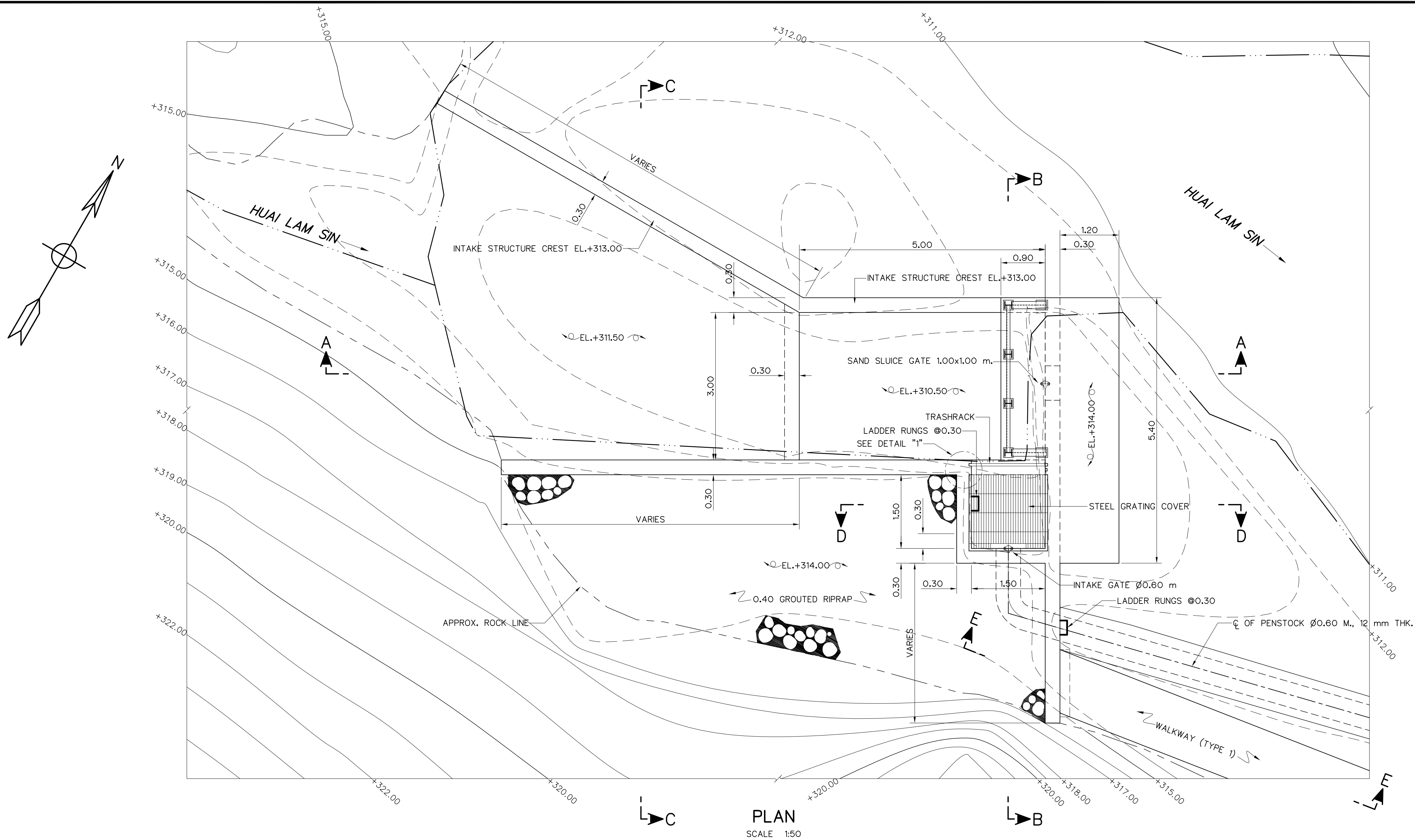
- NOTES :
- 1. ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
  - 2. SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03

- REFERENCE DRAWINGS :
- 1. INTAKE STRUCTURE, PLAN AND SECTION A-A HLS-IS-02

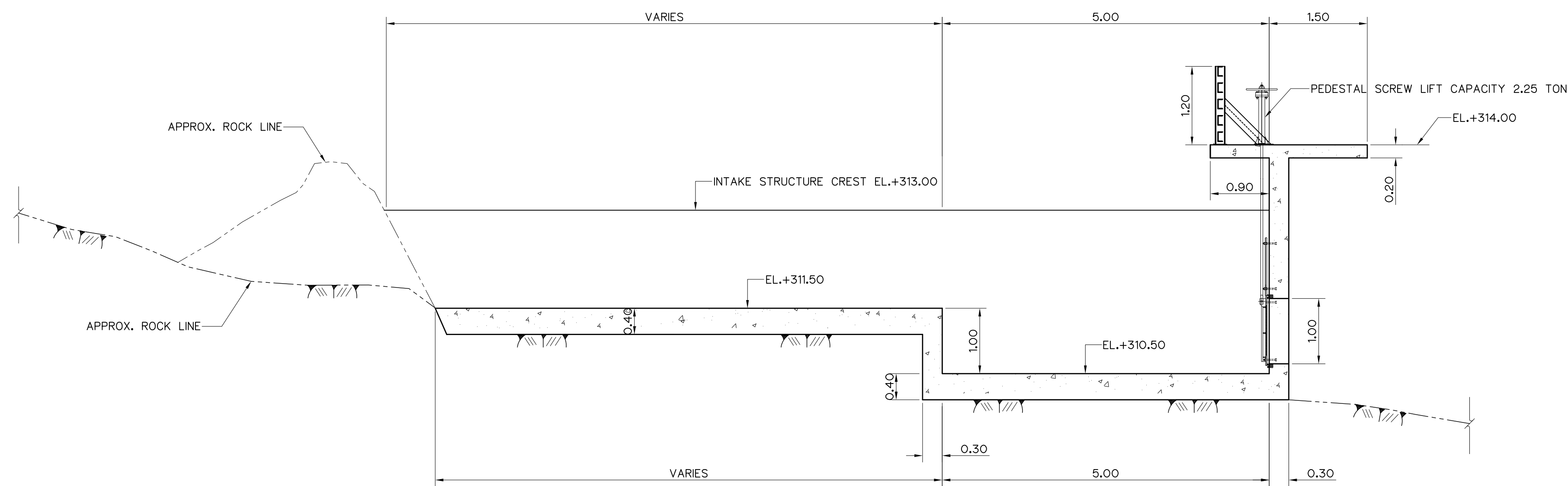


|             |      |           |         |          |
|-------------|------|-----------|---------|----------|
| 3           |      |           |         |          |
| 2           |      |           |         |          |
| 1           |      |           |         |          |
| NO.         | DATE | REVISIONS | CHECKED | APPROVED |
| CONSULTANTS |      |           | DEDE    |          |

|                                                                                                                                                                    |                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <div><div></div><div><div>KINGDOM OF THAILAND</div><div>Department of Alternative Energy Development and Efficiency</div><div>MINISTRY OF ENERGY</div></div></div> |                                                                                                                           |
| HUI LAM SIN HYDROPOWER PROJECT                                                                                                                                     |                                                                                                                           |
| CIVIL WORKS<br>INTAKE STRUCTURE<br>GENERAL LAY-OUT                                                                                                                 |                                                                                                                           |
| <div><div></div><div>FRONTIER ENGINEERING CONSULTANTS CO., LTD.</div></div>                                                                                        | <div><div></div><div>Department of Alternative Energy Development and Efficiency</div><div>MINISTRY OF ENERGY</div></div> |
| DESIGNED<br>NO. 14/01/62<br>PROJECT MANAGER                                                                                                                        | REVIEWED S.KITIKHAJ<br>SUBMITTED<br>RECOMMENDED<br>APPROVED<br>DATE                                                       |
| DRAWING NO. HLS-IS-01                                                                                                                                              | SHEET NO. 6 OF 25                                                                                                         |



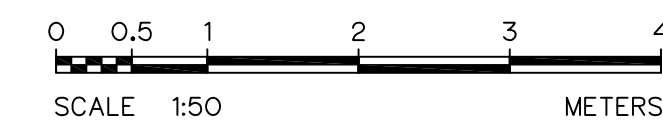
PLAN  
SCALE 1:50



SECTION A-A  
SCALE 1:50

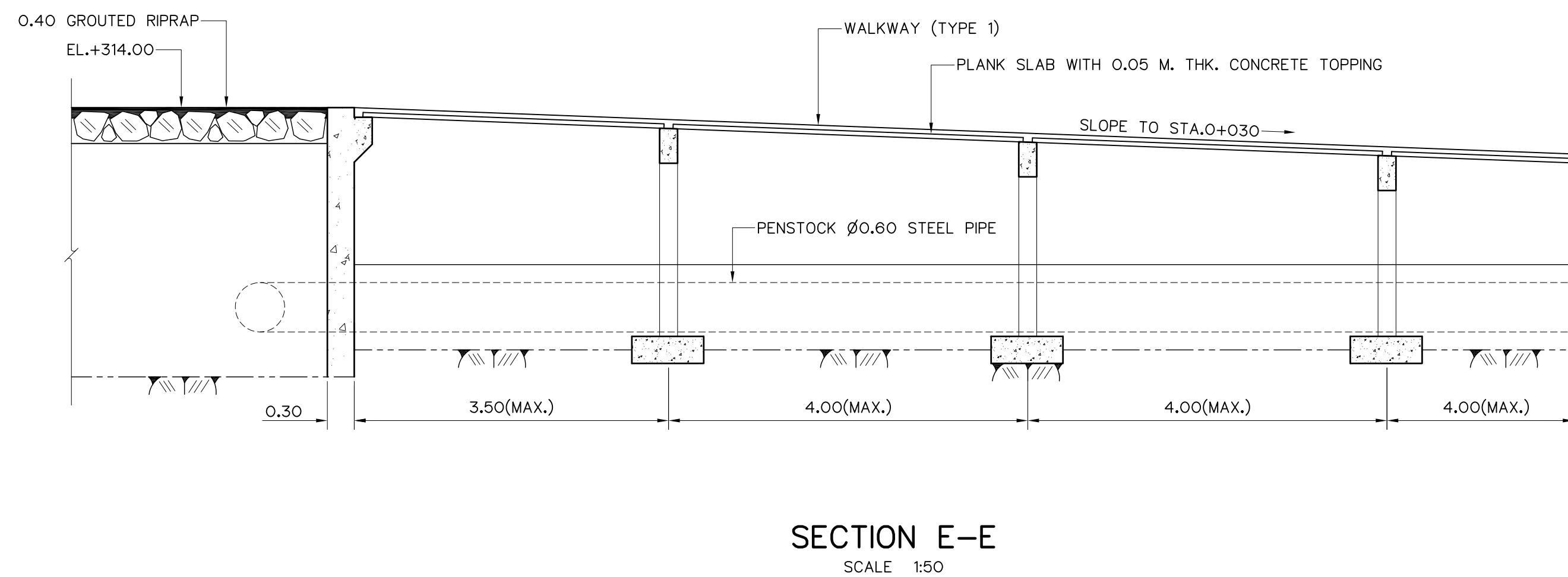
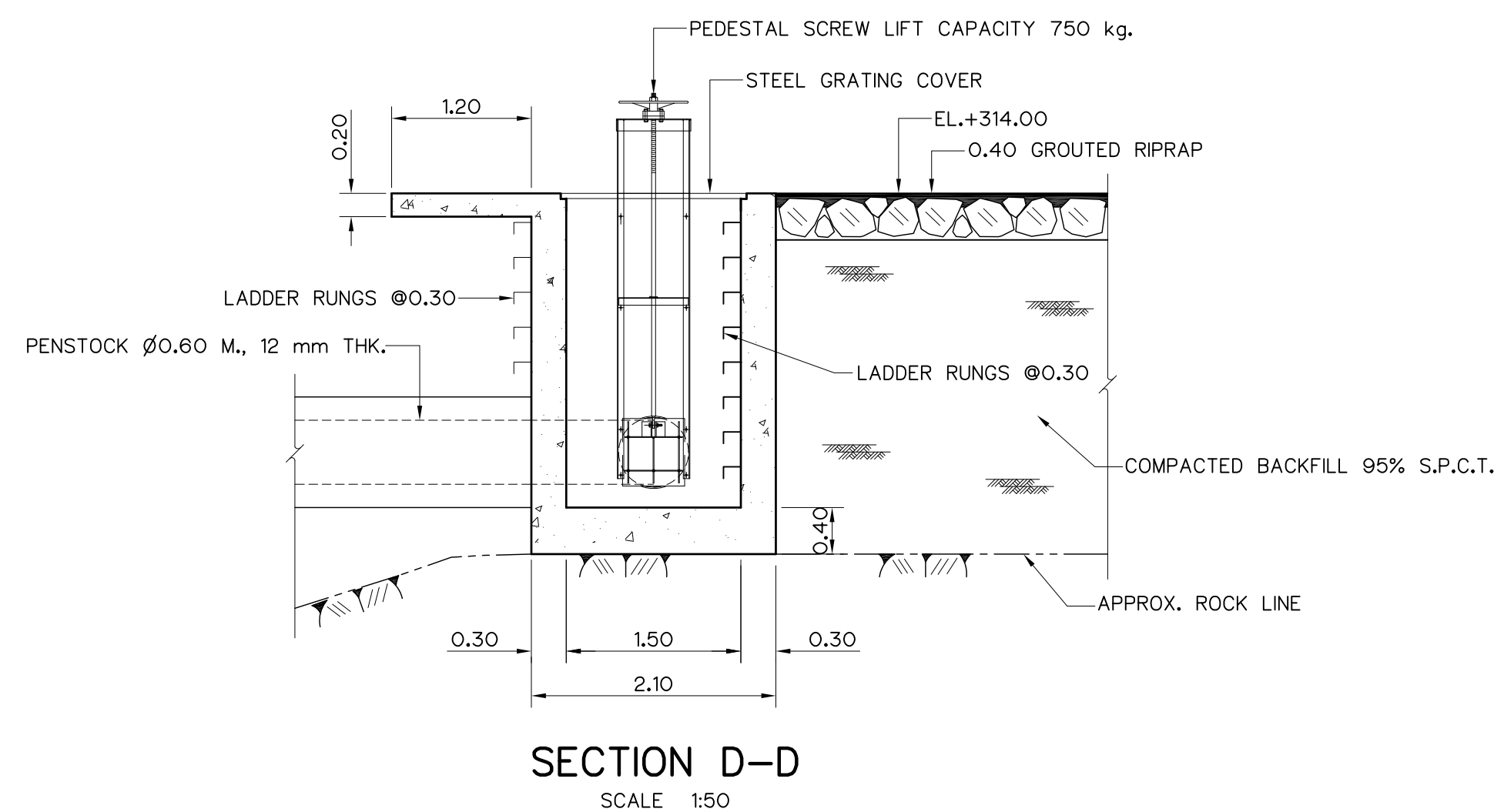
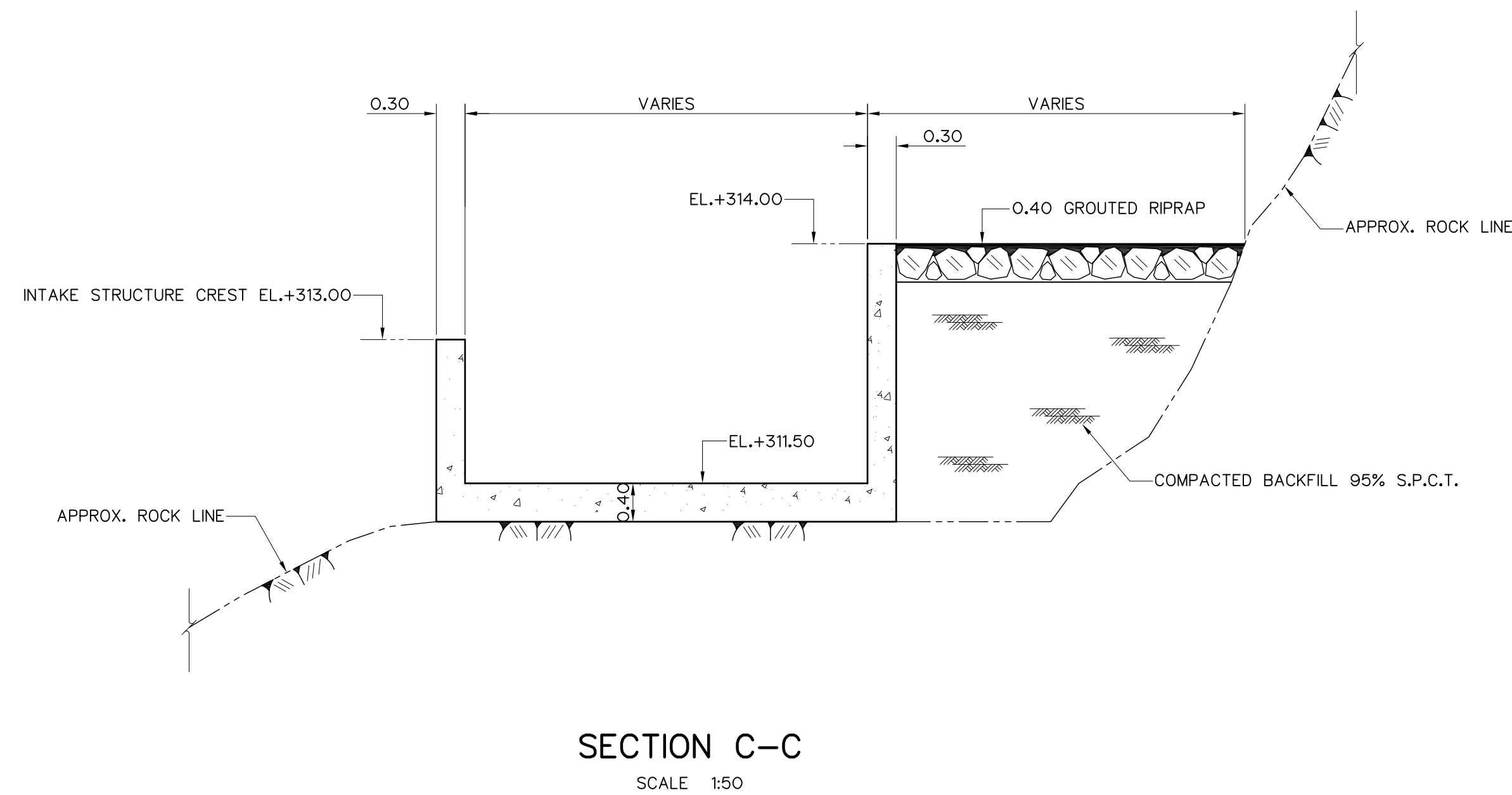
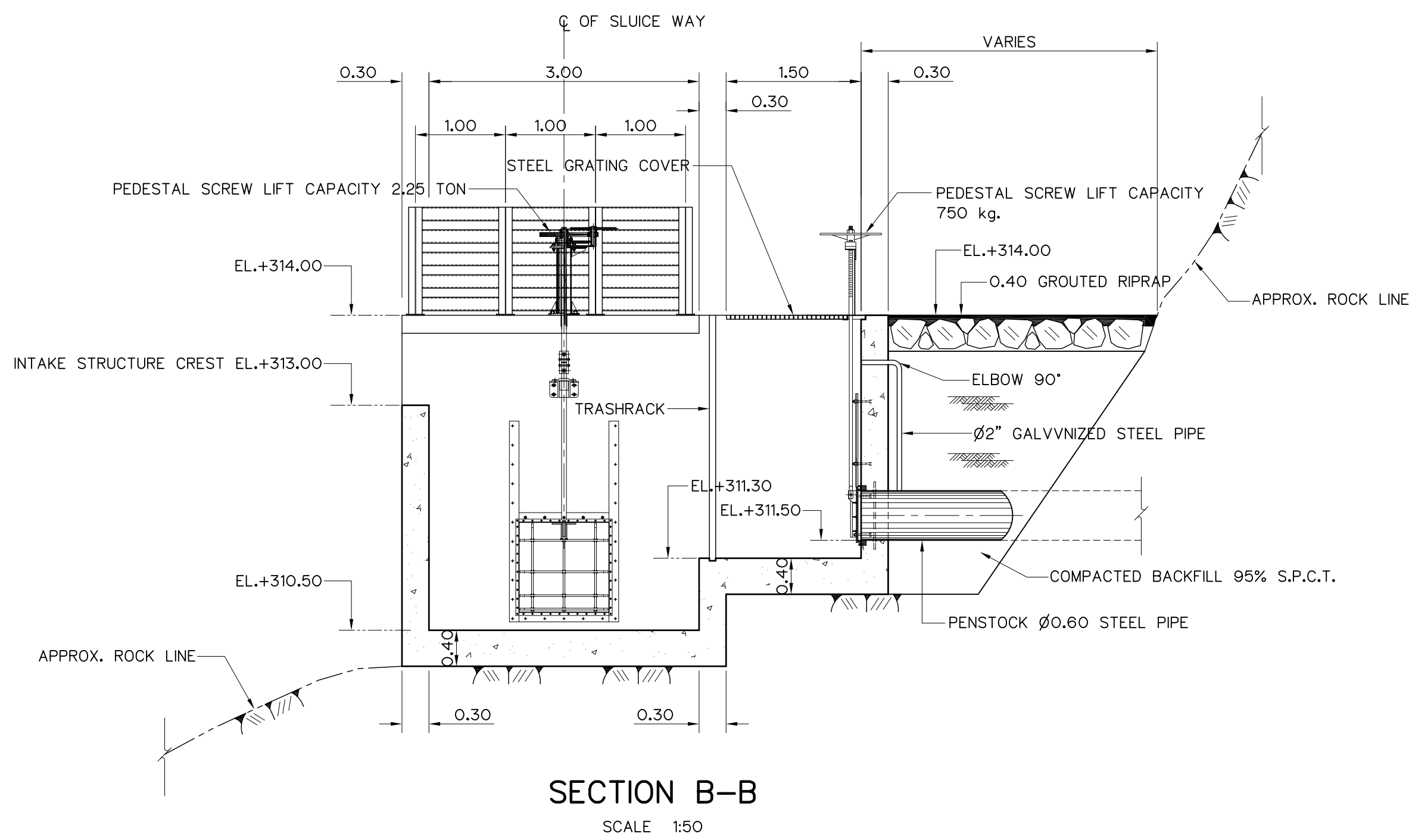
- NOTES :
1. ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
  2. SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03

- REFERENCE DRAWINGS :
1. INTAKE STRUCTURE, GENERAL LAY-OUT HLS-IS-01
  2. INTAKE STRUCTURE, SECTION B-B, C-C, D-D AND E-E HLS-IS-03



|                                                                                                             |                                                                                      |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                                                                                      |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                             |                                                                                      |
| CIVIL WORKS<br>INTAKE STRUCTURE<br>PLAN AND SECTION A-A                                                     |                                                                                      |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   | Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| REVIEWED S.KTICHAJ                                                                                          | SUBMITTED                                                                            |
| DESIGNED                                                                                                    | RECOMMENDED                                                                          |
| DRAWN                                                                                                       | APPROVED                                                                             |
| CHECKED                                                                                                     |                                                                                      |
| NO. DATE REVISIONS CHECKED APPROVED                                                                         | DRAWING NO. SHEET NO.                                                                |
| CONSULTANTS DEDE                                                                                            | HLS-IS-02 7 OF 25                                                                    |

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| 3   |      |           |         |          |
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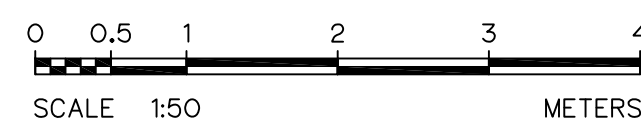


#### NOTES :

- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
- SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03

#### REFERENCE DRAWINGS :

- INTAKE STRUCTURE, PLAN AND SECTION A-A HLS-IS-02



| 3   |      |           |         |          |
|-----|------|-----------|---------|----------|
| 2   |      |           |         |          |
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CONSULTANTS

DEDE

|                                                                                                                       |                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <p>KINGDOM OF THAILAND<br/>Department of Alternative<br/>Energy Development and Efficiency<br/>MINISTRY OF ENERGY</p> |                                                                                               |
| <p>HUAI LAM SIN HYDROPOWER PROJECT</p>                                                                                |                                                                                               |
| <p>CIVIL WORKS<br/>INTAKE STRUCTURE<br/>SECTION B-B, C-C, D-D, E-E AND DETAILS</p>                                    |                                                                                               |
| <p>FRONTIER ENGINEERING CONSULTANTS CO.,LTD.</p>                                                                      | <p>Department of Alternative<br/>Energy Development and Efficiency<br/>MINISTRY OF ENERGY</p> |
| DESIGNED                                                                                                              | REVIEWED S.KITIKHAJ                                                                           |
| DRAWN                                                                                                                 | SUBMITTED                                                                                     |
| CHECKED                                                                                                               | RECOMMENDED                                                                                   |
| APPROVED                                                                                                              | APPROVED                                                                                      |
| PROJECT MANAGER                                                                                                       | DRAWING NO. HLS-IS-03                                                                         |
| DATE 14/01/62                                                                                                         | SHEET NO. 8 OF 25                                                                             |

HORIZONTAL ALINEMENT OF HEADRACE

| NO. PI. | COORDINATE  |             | PI. - PI.<br>(m) | DEFLECTION ANGLE<br>( ° ' - " ) | PI. STA.<br>(km) | BEARING<br>(N/S ° ' - " E/W) |
|---------|-------------|-------------|------------------|---------------------------------|------------------|------------------------------|
|         | N           | E           |                  |                                 |                  |                              |
| PI.1    | 827,364.921 | 598,407.056 | -                | -                               | 0+000.000        | -                            |
| PI.2    | 827,363.779 | 598,407.716 | 1.319            | 73°-50'-36.53"                  | 0+001.319        | S 30°-01'-30.19" E           |
| PI.3    | 827,365.924 | 598,416.404 | 8.949            | 04°-36'-56.57"                  | 0+010.268        | N 76°-07'-53.27" E           |
| PI.4    | 827,368.982 | 598,435.175 | 19.018           | 07°-21'-54.54"                  | 0+029.286        | N 80°-44'-49.85" E           |
| PI.5    | 827,371.589 | 598,443.910 | 9.116            | 01°-21'-56.49"                  | 0+038.402        | N 73°-22'-55.31" E           |
| PI.6    | 827,375.777 | 598,459.269 | 15.920           | 26°-49'-05.66"                  | 0+054.322        | N 74°-44'-51.80" E           |
| PI.7    | 827,372.486 | 598,475.350 | 16.414           | 10°-50'-26.65"                  | 0+070.736        | S 78°-26'-02.54" E           |
| PI.8    | 827,372.294 | 598,490.518 | 15.169           | 17°-26'-27.05"                  | 0+085.905        | S 89°-16'-29.19" E           |
| PI.9    | 827,374.125 | 598,496.615 | 6.366            | 01°-56'-08.77"                  | 0+092.271        | N 73°-17'-03.76" E           |
| PI.10   | 827,376.585 | 598,505.939 | 9.643            | 21°-59'-29.86"                  | 0+101.914        | N 75°-13'-12.53" E           |
| PI.11   | 827,374.734 | 598,520.567 | 14.745           | 26°-48'-52.82"                  | 0+116.659        | S 82°-47'-17.62" E           |
| PI.12   | 827,369.209 | 598,528.750 | 9.874            | 30°-37'-32.44"                  | 0+126.533        | S 55°-58'-24.80" E           |
| PI.13   | 827,366.754 | 598,570.063 | 41.386           | 19°-15'-35.63"                  | 0+167.919        | S 86°-35'-57.24" E           |
| PI.14   | 827,368.923 | 598,577.698 | 7.937            | 17°-13'-19.48"                  | 0+175.856        | N 74°-08'-27.13" E           |
| PI.15   | 827,373.496 | 598,584.718 | 8.378            | 59°-23'-15.56"                  | 0+184.234        | N 56°-55'-07.66" E           |
| PI.16   | 827,370.510 | 598,590.758 | 6.738            | 03°-01'-30.56"                  | 0+190.972        | S 63°-41'-36.78" E           |
| PI.17   | 827,366.534 | 598,597.834 | 8.117            | 01°-33'-36.43"                  | 0+199.089        | S 60°-40'-06.22" E           |
| PI.18   | 827,363.268 | 598,604.036 | 7.009            | 51°-58'-30.04"                  | 0+206.098        | S 62°-13'-42.66" E           |
| PI.19   | 827,369.769 | 598,618.499 | 15.857           | 29°-59'-56.85"                  | 0+221.955        | N 65°-47'-47.30" E           |
| PI.20   | 827,376.364 | 598,623.255 | 8.131            | 54°-59'-35.88"                  | 0+230.086        | N 35°-47'-50.45" E           |
| PI.21   | 827,399.839 | 598,615.082 | 24.857           | 34°-12'-43.18"                  | 0+254.943        | N 19°-11'-45.42" W           |
| PI.22   | 827,407.716 | 598,617.195 | 8.155            | 33°-09'-39.47"                  | 0+263.098        | N 15°-00'-57.76" E           |
| PI.23   | 827,413.025 | 598,623.128 | 7.962            | 31°-40'-04.90"                  | 0+271.060        | N 48°-10'-37.23" E           |
| PI.24   | 827,414.514 | 598,631.441 | 8.445            | 03°-10'-09.96"                  | 0+279.505        | N 79°-50'-42.13" E           |
| PI.25   | 827,415.524 | 598,639.684 | 8.305            | 01°-17'-36.30"                  | 0+287.810        | N 83°-00'-52.09" E           |
| PI.26   | 827,416.289 | 598,647.359 | 7.713            | 57°-09'-07.01"                  | 0+295.523        | N 84°-18'-28.39" E           |
| PI.27   | 827,410.439 | 598,652.019 | 7.479            | 22°-53'-14.41"                  | 0+303.002        | S 38°-32'-24.60" E           |
| PI.28   | 827,402.409 | 598,654.269 | 8.339            | 31°-18'-32.43"                  | 0+311.341        | S 15°-39'-10.20" E           |
| PI.29   | 827,397.024 | 598,660.036 | 7.890            | 28°-44'-10.09"                  | 0+319.231        | S 46°-57'-42.62" E           |
| PI.30   | 827,395.022 | 598,667.889 | 8.104            | 35°-40'-17.48"                  | 0+327.335        | S 75°-41'-52.71" E           |
| PI.31   | 827,398.029 | 598,675.574 | 8.252            | 06°-50'-20.35"                  | 0+335.587        | N 68°-37'-49.81" E           |
| PI.32   | 827,399.990 | 598,683.140 | 7.816            | 47°-38'-41.80"                  | 0+343.403        | N 75°-28'-10.15" E           |
| PI.33   | 827,391.876 | 598,695.580 | 14.852           | 02°-36'-23.54"                  | 0+358.255        | S 56°-53'-08.04" E           |
| PI.34   | 827,386.169 | 598,703.516 | 9.775            | 39°-38'-12.15"                  | 0+368.030        | S 54°-16'-44.51" E           |
| PI.35   | 827,378.449 | 598,705.533 | 7.979            | 03°-27'-21.96"                  | 0+376.009        | S 14°-38'-32.36" E           |
| PI.36   | 827,369.984 | 598,707.207 | 8.629            | 03°-02'-35.55"                  | 0+384.638        | S 11°-11'-10.40" E           |
| PI.37   | 827,361.896 | 598,709.258 | 8.344            | 40°-12'-02.48"                  | 0+392.982        | S 14°-13'-45.96" E           |
| PI.38   | 827,349.984 | 598,725.915 | 20.478           | 01°-52'-20.66"                  | 0+413.460        | S 54°-25'-48.44" E           |

NOTES :

- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
- SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
- THE ALIGNMENT OF THE PENSTOCK AND RELATED STRUCTURES SHALL BE CHECK AND CORRECTED BY THE CONTRACTOR TO SUIT THE FIELD CONDITIONS AND SHALL BE SUBMITTED TO DEDE'S FIELD ENGINEER FOR APPROVAL

REFERENCE DRAWINGS :

- PENSTOCK, PIER TYPE 1 DETAILS HLS-PS-07

KINGDOM OF THAILAND  
Department of Alternative  
Energy Development and Efficiency  
MINISTRY OF ENERGY

HUAI LAM SIN HYDROPOWER PROJECT

CIVIL WORKS

PENSTOCK

PLAN AND PROFILE, STA. 0+000 TO STA. 0+400

FRONTIER ENGINEERING CONSULTANTS CO.,LTD.

Department of Alternative  
Energy Development and Efficiency  
MINISTRY OF ENERGY

DESIGNED ๒๒.6651

SUBMITTED ๒๒.๖๖๕๑

DRAWN ๒๒.๖๖๕๑

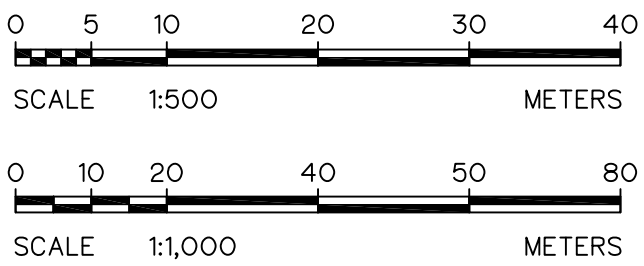
RECOMMENDED ๒๒.๖๖๕๑

CHECKED ๒๒.๖๖๕๑

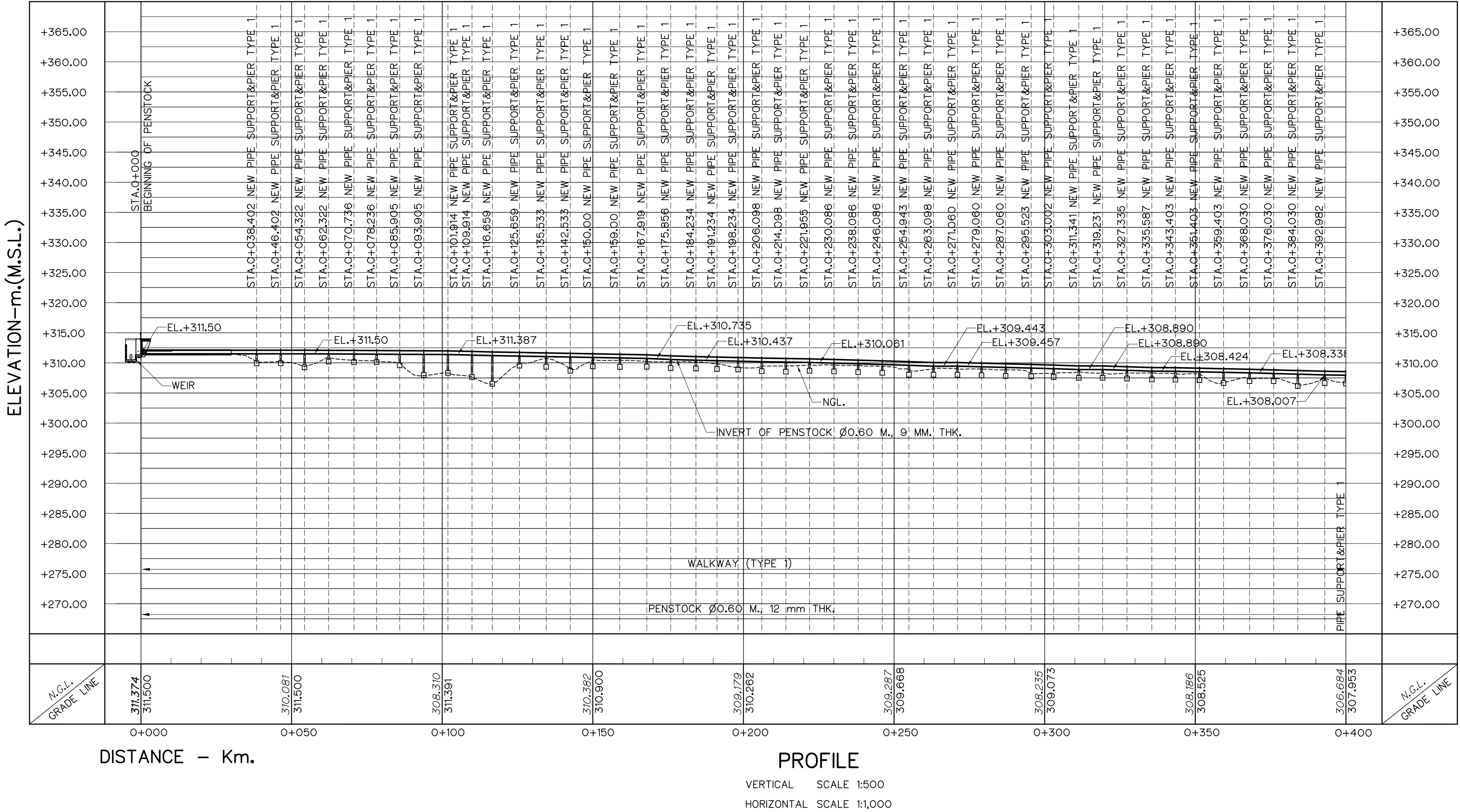
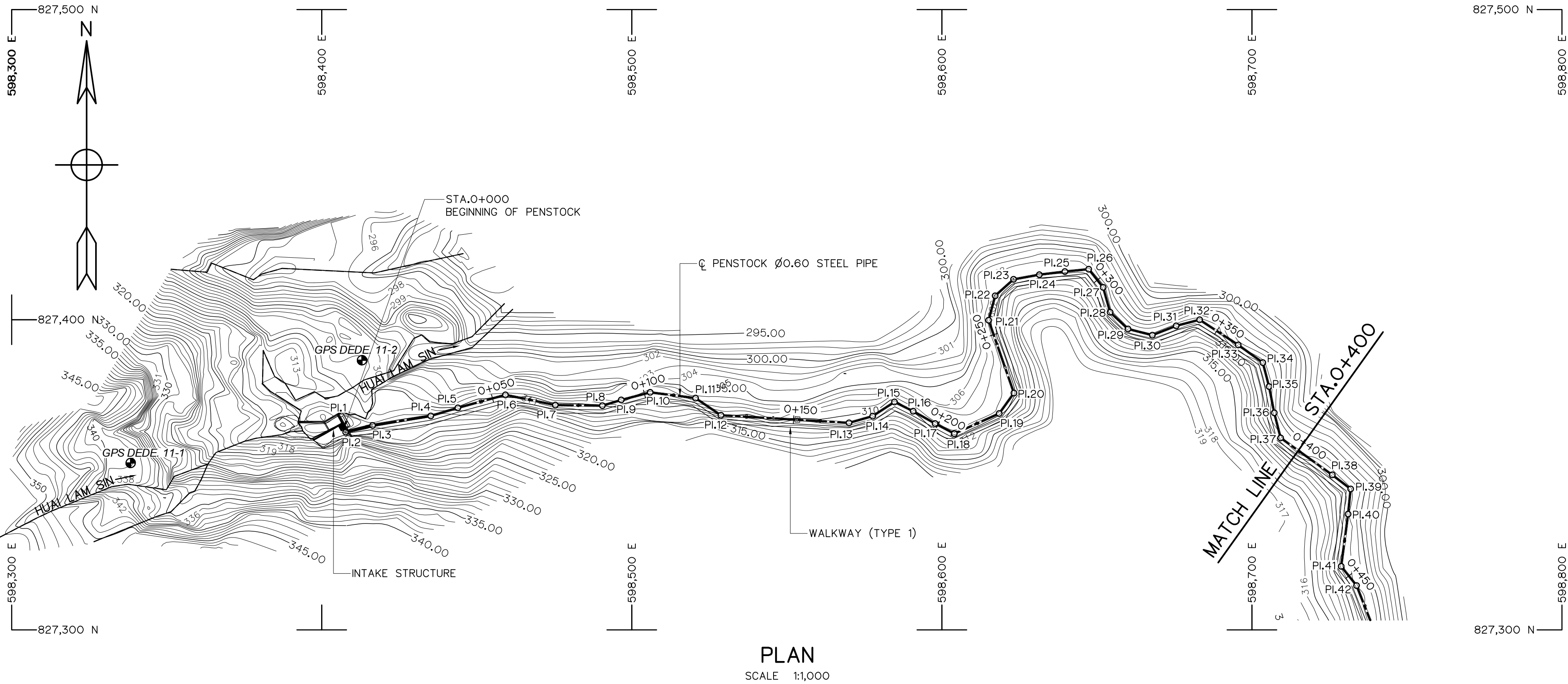
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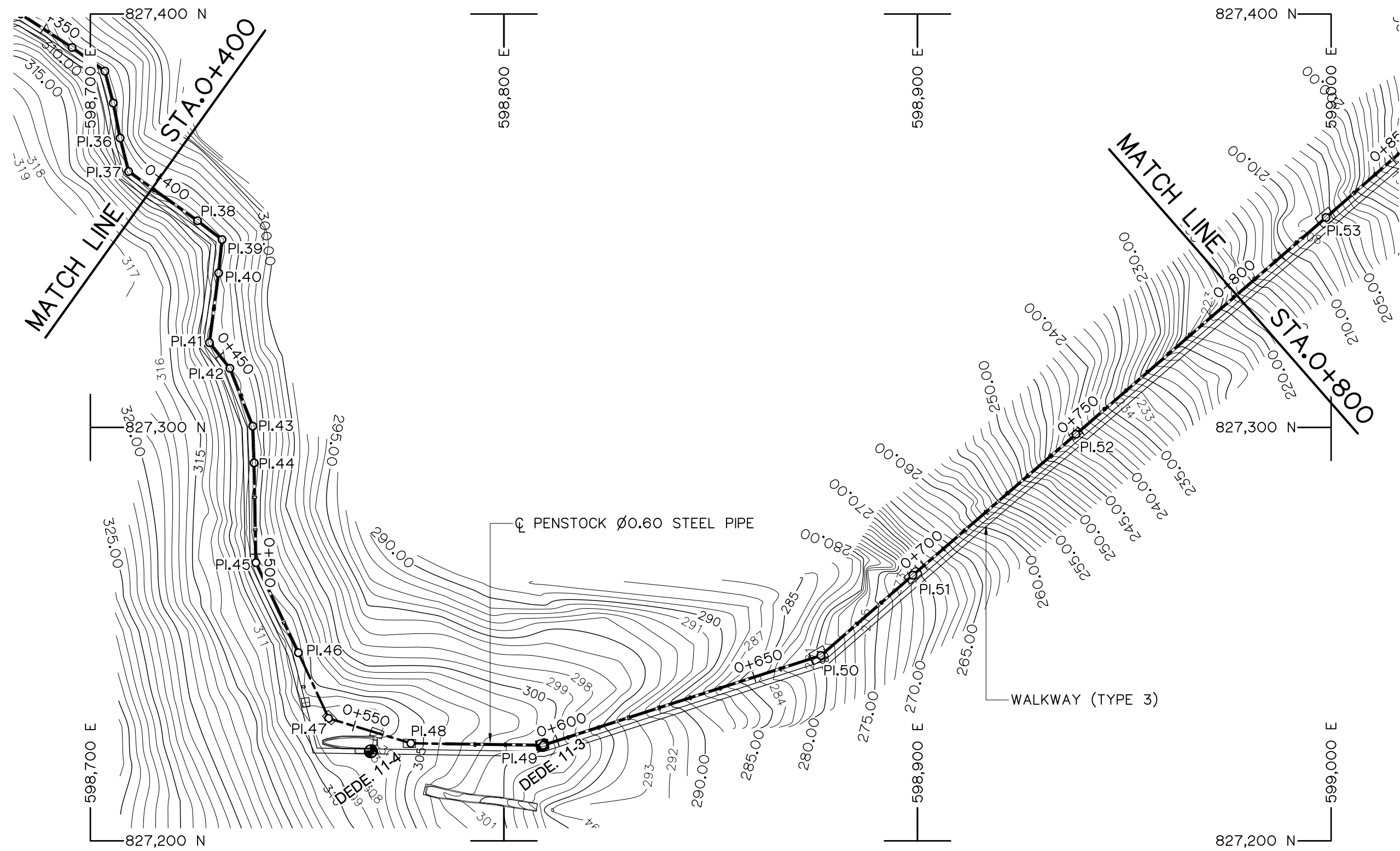
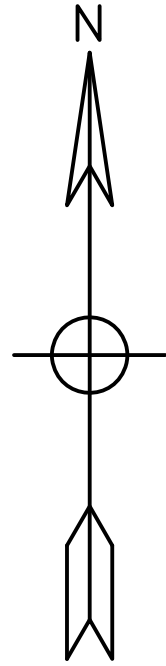
PROJECT MANAGER 14/01/62 DATE

DRAWING NO. HLS-PS-01 SHEET NO. 9 OF 25

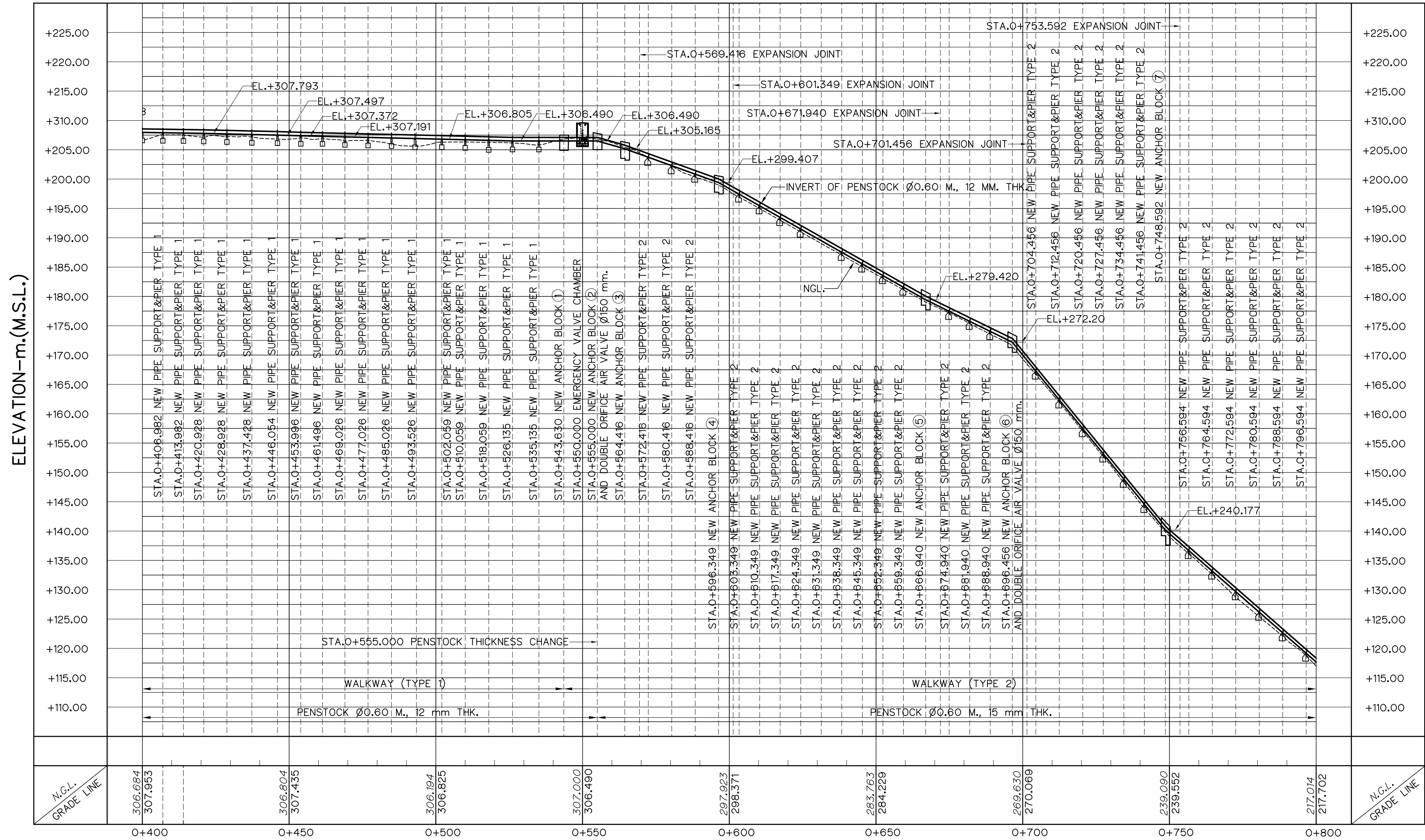


|             |      |           |         |          |
|-------------|------|-----------|---------|----------|
| 3           |      |           |         |          |
| 2           |      |           |         |          |
| 1           |      |           |         |          |
| NO.         | DATE | REVISIONS | CHECKED | APPROVED |
| CONSULTANTS |      |           | DEDE    |          |





PLAN  
SCALE 1:1,000



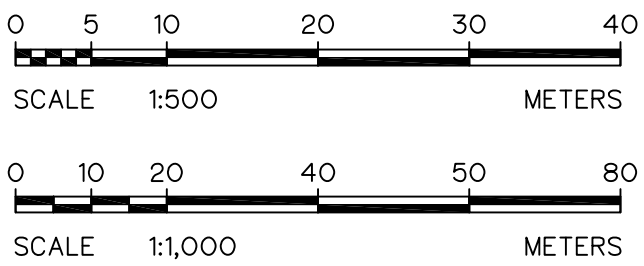
PROFILE  
VERTICAL SCALE 1:500  
HORIZONTAL SCALE 1:1,000

HORIZONTAL ALINEMENT OF PENSTOCK

| NO. PI. | COORDINATE  |             | PI. - PI.<br>(m) | DEFLECTION ANGLE<br>( ° - ' - " ) | PI. STA.<br>(km) | BEARING<br>(N/S ° - ' - " E/W) |
|---------|-------------|-------------|------------------|-----------------------------------|------------------|--------------------------------|
|         | N           | E           |                  |                                   |                  |                                |
| PI.37   | 827,361.896 | 598,709.258 | 8.344            | 40°-12'-02.48"                    | 0+392.982        | S 14°-13'-45.96"E              |
| PI.38   | 827,349.984 | 598,725.915 | 20.478           | 01°-52'-20.66"                    | 0+413.460        | S 54°-25'-48.44"E              |
| PI.39   | 827,345.444 | 598,731.844 | 7.468            | 58°-24'-15.16"                    | 0+420.928        | S 52°-33'-27.78"E              |
| PI.40   | 827,337.348 | 598,731.015 | 8.138            | 01°-39'-19.56"                    | 0+429.066        | S 5°-50'-47.39"W               |
| PI.41   | 827,320.505 | 598,728.797 | 16.988           | 46°-05'-46.96"                    | 0+446.054        | S 7°-30'-06.95"W               |
| PI.42   | 827,314.298 | 598,733.751 | 7.942            | 17°-04'-06.28"                    | 0+453.998        | S 38°-35'-40.05"E              |
| PI.43   | 827,300.316 | 598,739.266 | 15.030           | 19°-34'-47.91"                    | 0+469.026        | S 21°-31'-33.77"E              |
| PI.44   | 827,291.428 | 598,739.568 | 8.893            | 00°-50'-58.11"                    | 0+477.919        | S 1°-56'-45.85"E               |
| PI.45   | 827,267.292 | 598,740.030 | 24.140           | 24°-10'-00.20"                    | 0+502.059        | S 1°-05'-47.74"E               |
| PI.46   | 827,245.519 | 598,750.305 | 24.076           | 10°-56'-35.31"                    | 0+526.135        | S 25°-15'-47.94"E              |
| PI.47   | 827,229.638 | 598,757.645 | 17.495           | 48°-21'-22.88"                    | 0+543.630        | S 24°-48'-20.85"E              |
| PI.48   | 827,223.617 | 598,777.540 | 20.786           | 15°-59'-07.95"                    | 0+564.416        | S 73°-09'-43.72"E              |
| PI.47   | 827,229.638 | 598,757.645 | 17.495           | 48°-21'-22.88"                    | 0+543.630        | S 24°-48'-20.85"E              |
| PI.48   | 827,223.617 | 598,777.540 | 20.786           | 15°-59'-07.95"                    | 0+564.416        | S 73°-09'-43.72"E              |
| PI.49   | 827,223.142 | 598,809.469 | 31.933           | 18°-45'-26.90"                    | 0+596.349        | S 89°-08'-51.67"E              |
| PI.50   | 827,244.844 | 598,876.639 | 70.589           | 23°-14'-41.26"                    | 0+666.938        | N 72°-05'-41.42"E              |
| PI.51   | 827,264.268 | 598,898.866 | 29.518           | 00°-19'-38.72"                    | 0+696.456        | N 48°-51'-00.17"E              |
| PI.52   | 827,298.350 | 598,938.319 | 52.136           | 00°-06'-01.70"                    | 0+748.592        | N 49°-10'-38.89"E              |
| PI.53   | 827,350.775 | 598,998.791 | 80.033           | 00°-15'-03.29"                    | 0+828.625        | N 49°-04'-37.19"E              |

- NOTES :
- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
  - SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
  - THE ALIGNMENT OF THE PENSTOCK AND RELATED STRUCTURES SHALL BE CHECK AND CORRECTED BY THE CONTRACTOR TO SUIT THE FIELD CONDITIONS AND SHALL BE SUBMITTED TO DEDE'S FIELD ENGINEER FOR APPROVAL

- REFERENCE DRAWINGS :
- PENSTOCK, PIER TYPE 1 DETAILS HLS-PS-07
  - PENSTOCK, PIER TYPE 2 DETAILS HLS-PS-08

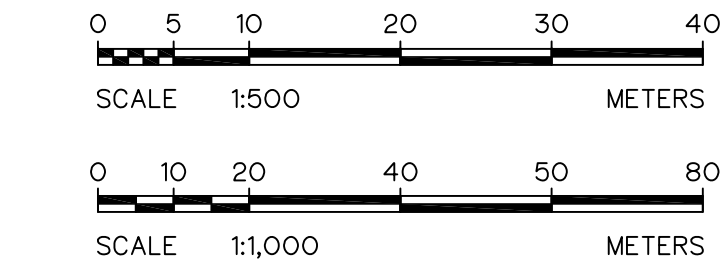
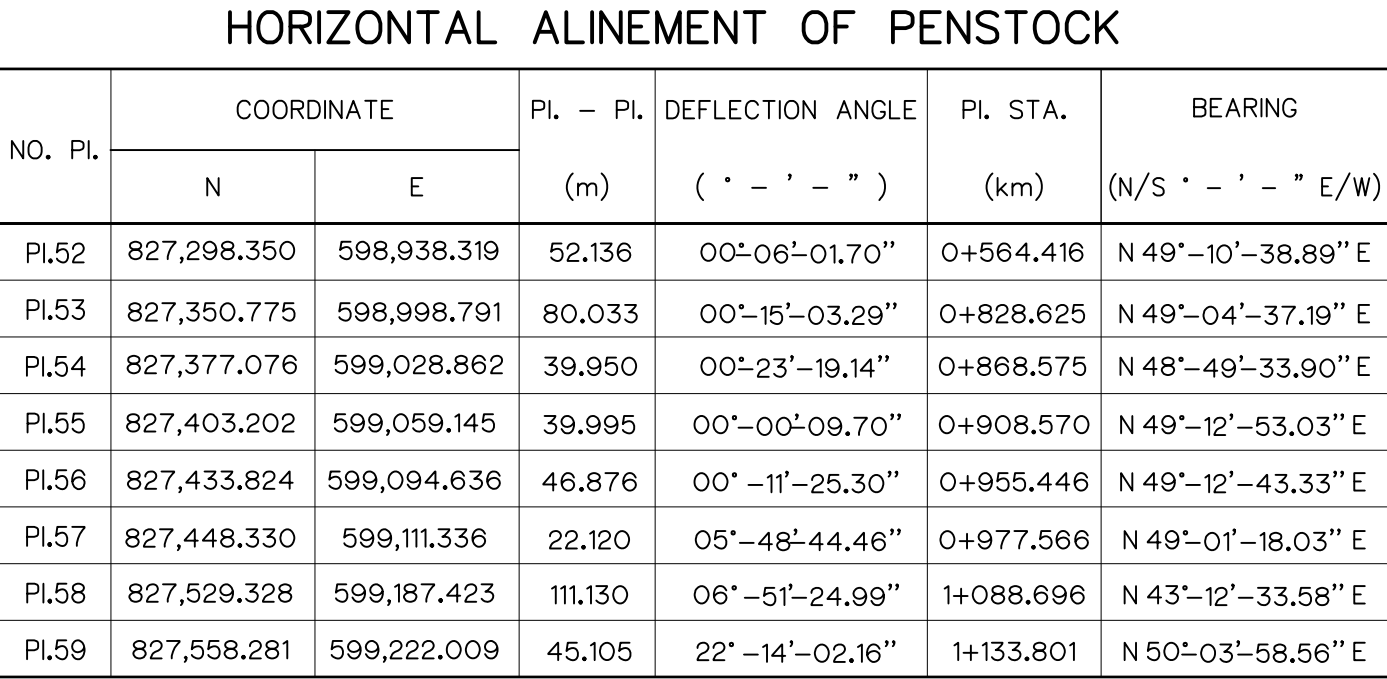


KINGDOM OF THAILAND  
Department of Alternative  
Energy Development and Efficiency  
MINISTRY OF ENERGY

HUAI LAM SIN HYDROPOWER PROJECT

CIVIL WORKS  
PENSTOCK  
PLAN AND PROFILE, STA. 0+400 TO STA. 0+800

|             |      |           |         |          |          |                                           |                                                                                      |
|-------------|------|-----------|---------|----------|----------|-------------------------------------------|--------------------------------------------------------------------------------------|
| 3           |      |           |         |          |          | FRONTIER ENGINEERING CONSULTANTS CO.,LTD. | Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| 2           |      |           |         |          |          | DESIGNED                                  | REVIEWED S.KITICHAJ                                                                  |
| 1           |      |           |         |          |          | DRAWN                                     | SUBMITTED                                                                            |
| NO.         | DATE | REVISIONS | CHECKED | APPROVED |          | CHECKED                                   | RECOMMENDED                                                                          |
|             |      |           |         |          |          |                                           |                                                                                      |
| CONSULTANTS |      |           | DEDE    |          |          | PROJECT MANAGER                           | DRAWING NO.                                                                          |
|             |      |           |         |          | 14/01/62 | DATE                                      | SHEET NO.                                                                            |
|             |      |           |         |          |          |                                           | HLS-PS-02                                                                            |
|             |      |           |         |          |          |                                           | 10 OF 25                                                                             |

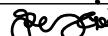
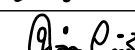
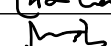


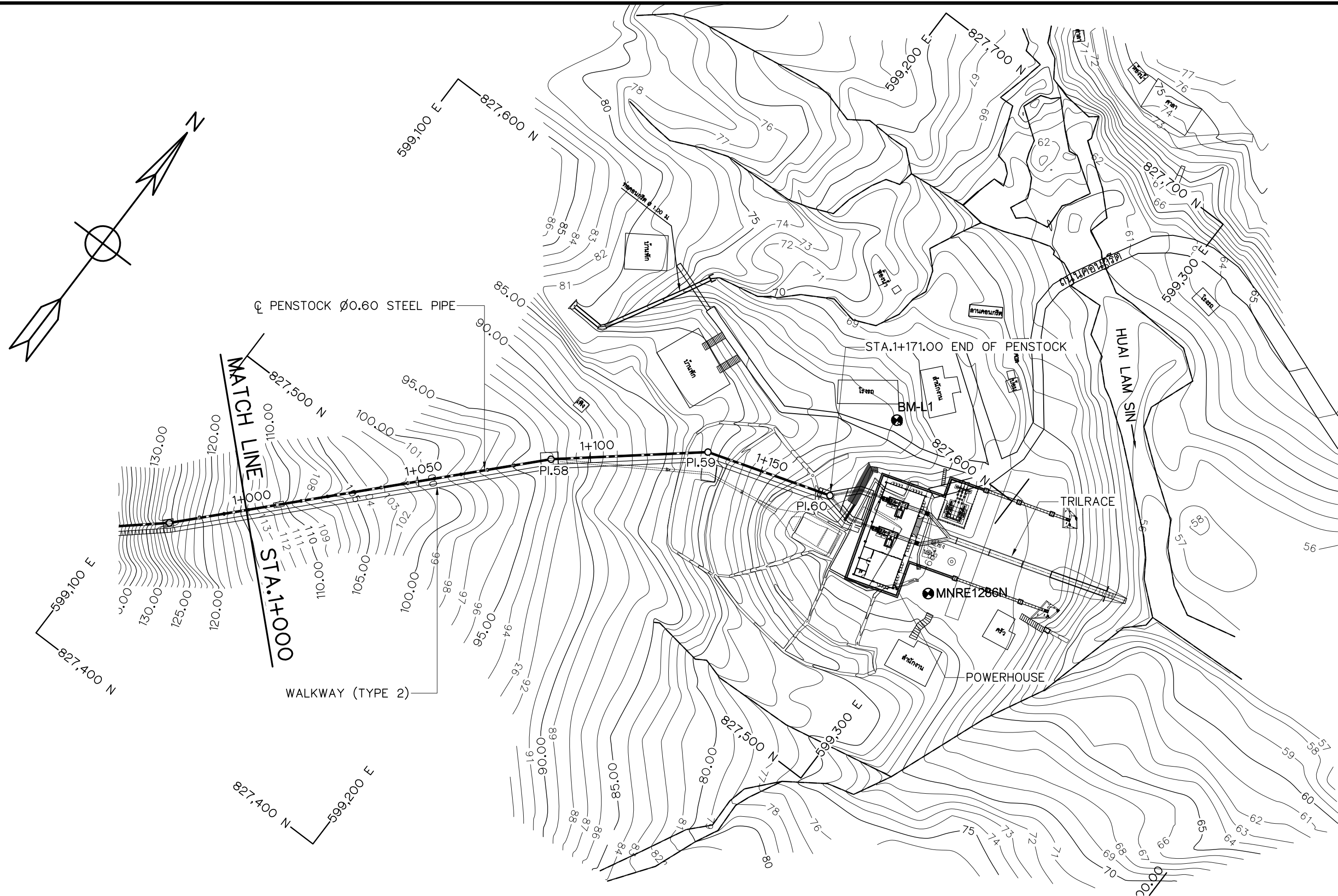
**NOTES :**

1. ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS. UNLESS OTHERWISE SHOWN.
2. SYMBOLE, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
3. THE ALIGNMENT OF THE PENSTOCK AND RELATED STRUCTURES SHALL BE CHECK AND CORRECTED BY THE CONTRACTOR TO SUIT THE FIELD CONDITIONS AND SHALL BE SUBMITTED TO DEDE'S FIELD ENGINEER FOR APPROVAL

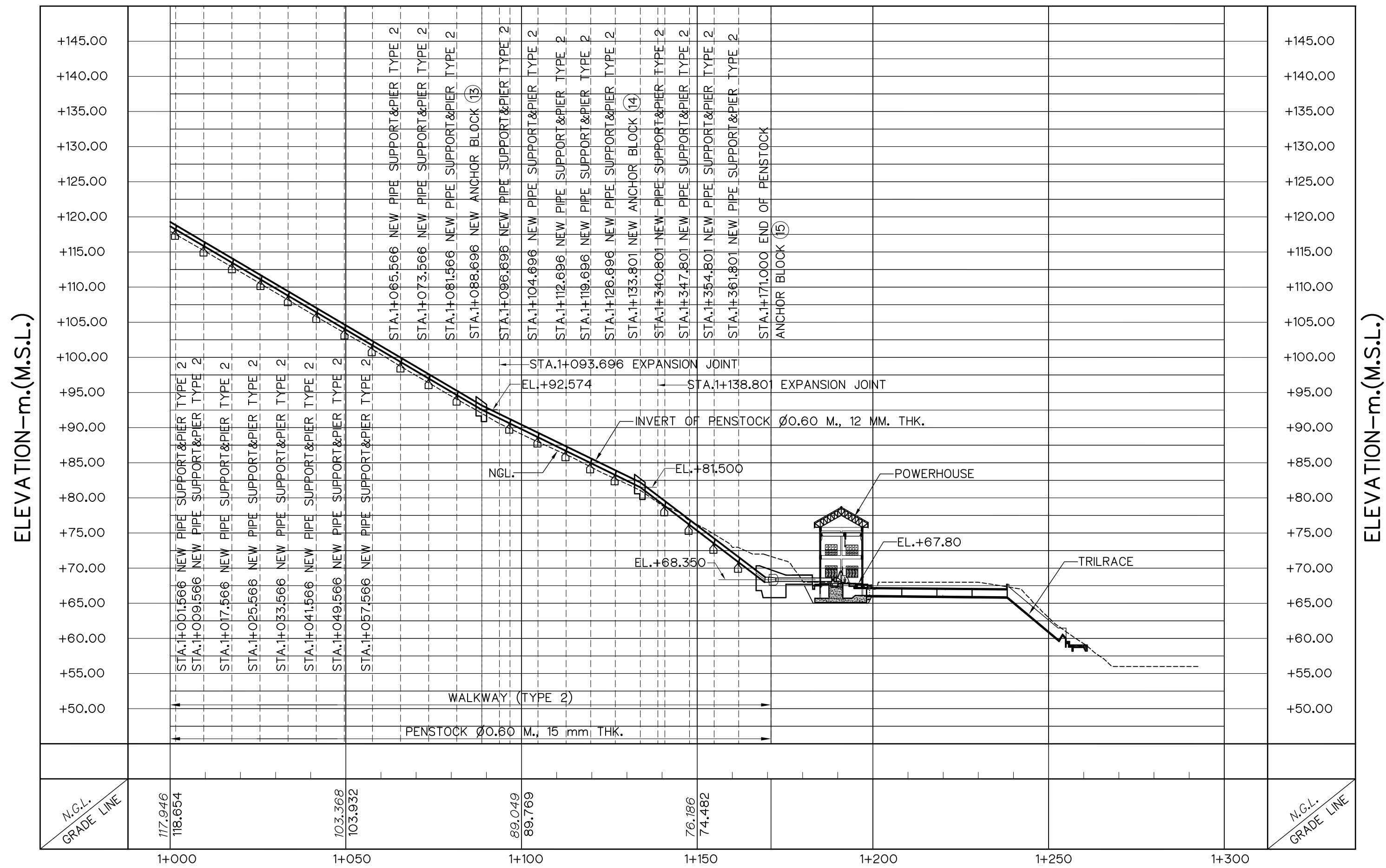
REFERENCE DRAWINGS :

1. PENSTOCK, PIER TYPE 2 DETAILS HLS-PS-08

|                                                                                                                                                                                                                                                                                |  |                                                                                                                                                                                                                                                |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  <div style="text-align: center;"> <b>KINGDOM OF THAILAND</b><br/>         Department of Alternative<br/>         Energy Development and Efficiency<br/> <b>MINISTRY OF ENERGY</b> </div> |  |                                                                                                                                                                                                                                                |  |
| <h1>HUAI LAM SIN HYDROPOWER PROJECT</h1>                                                                                                                                                                                                                                       |  |                                                                                                                                                                                                                                                |  |
| <h2>CIVIL WORKS</h2>                                                                                                                                                                                                                                                           |  |                                                                                                                                                                                                                                                |  |
| <h3>PENSTOCK</h3>                                                                                                                                                                                                                                                              |  |                                                                                                                                                                                                                                                |  |
| <h2>PLAN AND PROFILE, STA. 0+800 TO STA. 1+000</h2>                                                                                                                                                                                                                            |  |                                                                                                                                                                                                                                                |  |
|  <b>FRONTIER ENGINEERING CONSULTANTS CO.,LTD.</b>                                                                                                                                         |  |  <div style="text-align: center;">         Department of Alternative<br/>         Energy Development and Efficiency<br/> <b>MINISTRY OF ENERGY</b> </div> |  |
| DESIGNED                                                                                                                                                                                  |  | REVIEWED S.KITIKAI                                                                                                                                                                                                                             |  |
| DRAWN                                                                                                                                                                                     |  | SUBMITTED                                                                                                                                                 |  |
| CHECKED                                                                                                                                                                                   |  | RECOMMENDED                                                                                                                                               |  |
| 14/01/62                                                                                                                                                                                                                                                                       |  | APPROVED                                                                                                                                                  |  |
| <br>PROJECT MANAGER                                                                                                                                                                       |  | DRAWING NO.<br><b>HLS-PS-03</b>                                                                                                                                                                                                                |  |
| DATE                                                                                                                                                                                                                                                                           |  | SHEET NO.<br>11 OF 25                                                                                                                                                                                                                          |  |



PLAN  
SCALE 1:1,000



DISTANCE – Km.

PROFILE

VERTICAL SCALE 1:500  
HORIZONTAL SCALE 1:1,000

HORIZONTAL ALINEMENT OF PENSTOCK

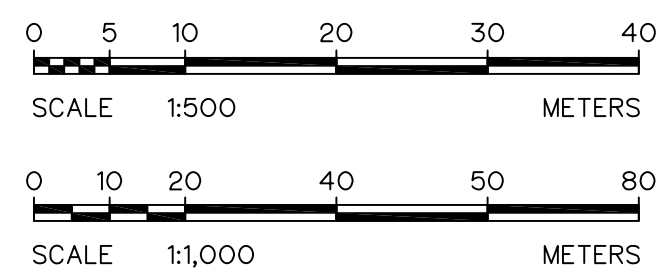
| NO. PL | COORDINATE  |             | PL. – PL.<br>(m) | DEFLECTION ANGLE<br>( ° - ' - " ) | PL. STA.<br>(km) | BEARING<br>(N/S ° - ' - " E/W) |
|--------|-------------|-------------|------------------|-----------------------------------|------------------|--------------------------------|
|        | N           | E           |                  |                                   |                  |                                |
| PL57   | 827,448.330 | 599,111.336 | 22.120           | 05°–48'–44.46"                    | 0+977.566        | N 49°–01'–18.03" E             |
| PL58   | 827,529.328 | 599,187.423 | 111.130          | 06°–51'–24.99"                    | 1+088.696        | N 43°–12'–33.58" E             |
| PL59   | 827,558.281 | 599,222.009 | 45.105           | 22°–14'–02.16"                    | 1+133.801        | N 50°–03'–58.56" E             |
| PL60   | 827,569.591 | 599,257.447 | 37.199           | –                                 | 1+171.000        | N 72°–17'–58.46" E             |

NOTES :

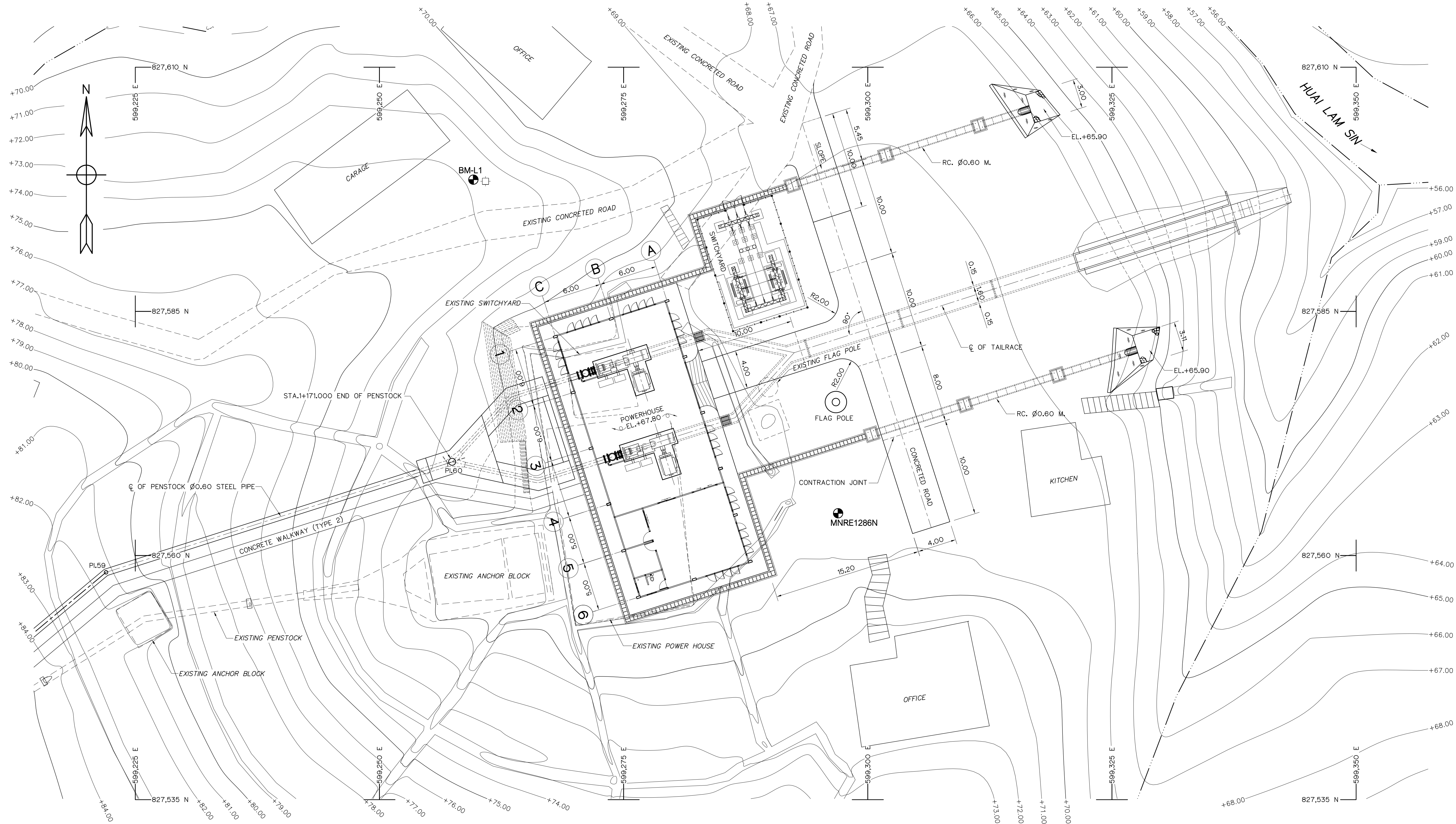
- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
- SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS–GN–03
- THE ALIGNMENT OF THE PENSTOCK AND RELATED STRUCTURES SHALL BE CHECK AND CORRECTED BY THE CONTRACTOR TO SUIT THE FIELD CONDITIONS AND SHALL BE SUBMITTED TO DEDE'S FIELD ENGINEER FOR APPROVAL

REFERENCE DRAWINGS :

- PENSTOCK, PIER TYPE 2 DETAILS HLS–PS–08



|     |      |           |         |          |  |                                           |                                                                                   |
|-----|------|-----------|---------|----------|--|-------------------------------------------|-----------------------------------------------------------------------------------|
| 3   |      |           |         |          |  | FRONTIER ENGINEERING CONSULTANTS CO.,LTD. | Department of Alternative Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| 2   |      |           |         |          |  | DESIGNED                                  | REVIEWED S.KITICHAJ                                                               |
| 1   |      |           |         |          |  | DRAWN                                     | SUBMITTED                                                                         |
| NO. | DATE | REVISIONS | CHECKED | APPROVED |  | CHECKED                                   | RECOMMENDED                                                                       |
|     |      |           |         |          |  | APPROVED                                  |                                                                                   |
|     |      |           |         |          |  | PROJECT MANAGER                           | DRAWING NO.                                                                       |
|     |      |           |         |          |  |                                           | SHEET NO.                                                                         |



GENERAL LAY-OUT  
SCALE 1:200

NOTES :

- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN
- SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
- THE CONTRACTOR SHALL CHECK THE STABILITY OF THE EXCAVATION LINE. IF IT IS NOT SUFFICIENTLY STABLE, THE CONTRACTOR SHALL SUBMIT A REPORT TO THE PROJECT ENGINEER FOR CONSIDERING THE WAY TO IMPROVE ITS STABILITY.
- FOR THE DETAILS OF THE STABILITY OF THE EXCAVATION LINE, SEE DWG. NO. HLS-PH-02

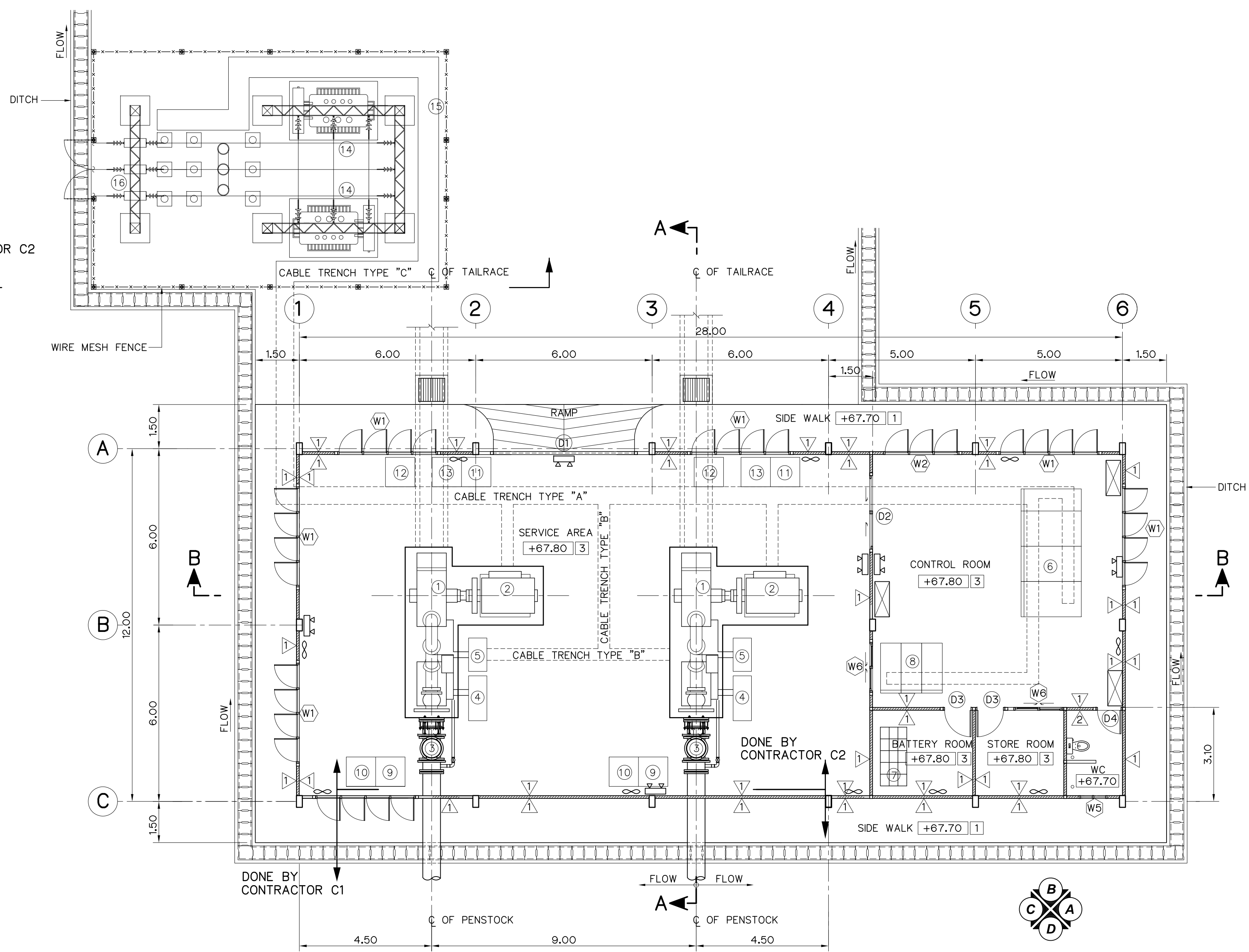
REFERENCE DRAWINGS :

- |                                   |           |
|-----------------------------------|-----------|
| 1. POWERHOUSE, PLAN AND ROOF PLAN | HLS-PH-02 |
| 2. POWERHOUSE, ELEVATIONS         | HLS-PH-03 |
| 3. POWERHOUSE, SECTIONS           | HLS-PH-04 |

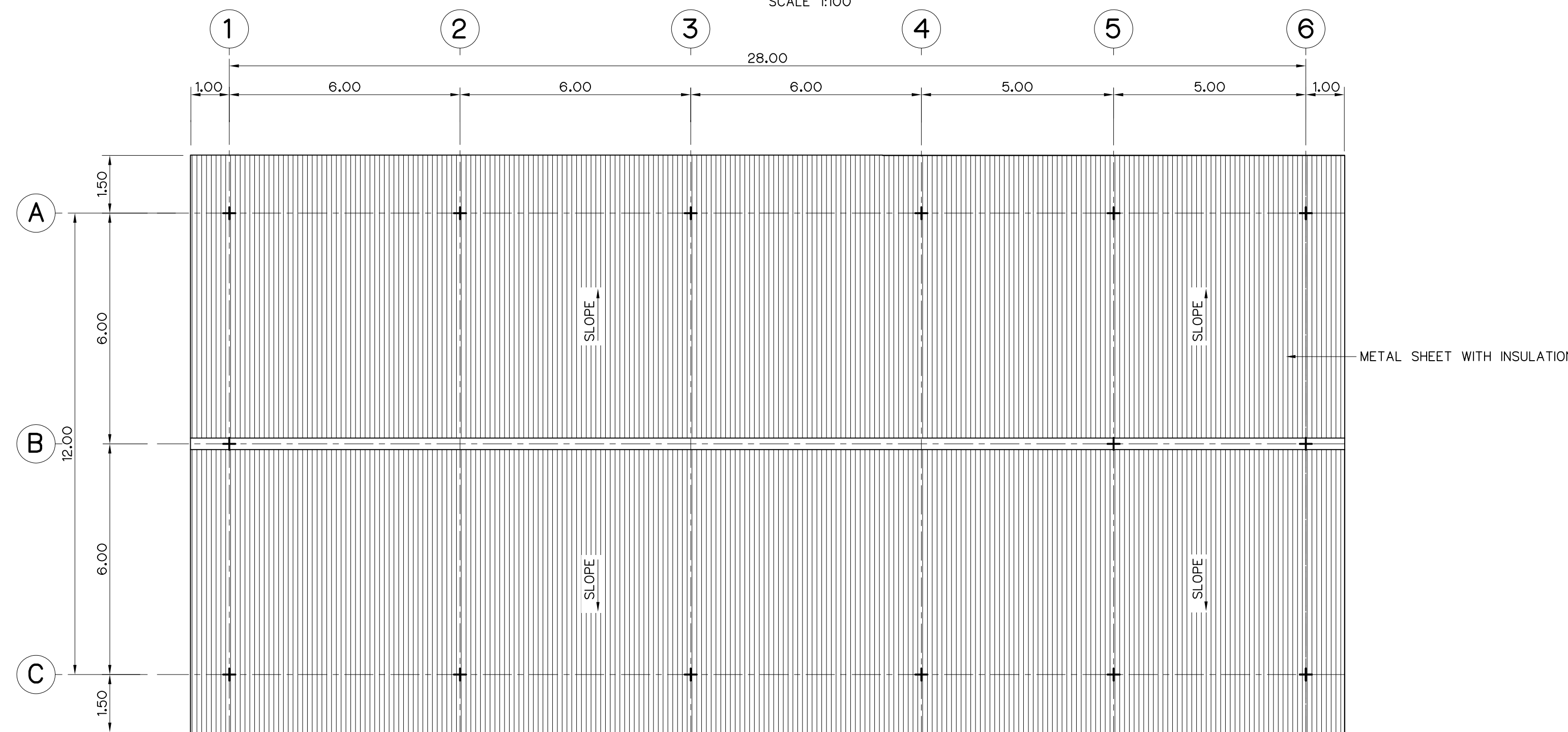


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| 3   |      |             |         |          |
| 2   |      |             |         |          |
| 1   |      |             |         |          |
| NO. | DATE | REVISIONS   | CHECKED | APPROVED |
|     |      | CONSULTANTS | DEDE    |          |

|                                                                                                             |                                                                                      |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                                                                                      |
| HUA I LAM SIN HYDROPOWER PROJECT                                                                            |                                                                                      |
| CIVIL WORKS<br>POWERHOUSE<br>GENERAL LAY-OUT                                                                |                                                                                      |
| FRONTIER ENGINEERING CONSULTANTS CO., LTD.                                                                  | Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| REVIEWED S.KITIKHAJ                                                                                         |                                                                                      |
| DESIGNED S. 6651                                                                                            | SUBMITTED                                                                            |
| DRAWN                                                                                                       | RECOMMENDED                                                                          |
| CHECKED S. 7324                                                                                             | APPROVED                                                                             |
| PROJECT MANAGER                                                                                             | DATE 14/01/62                                                                        |
| DRAWING NO. HLS-PH-01                                                                                       | SHEET NO. 13 OF 25                                                                   |



PLAN  
SCALE 1:100



ROOF PLAN  
SCALE 1:100

DESCRIPTION :

- 1 PELTON TURBINE
- 2 SYNCHROUSE GENERATOR
- 3 INLET VALVE AND BYPASS VALVE
- 4 PRESSURE OIL EQUIPMENT
- 5 GOVERNOR AND TURBINE CONTROL PANEL
- 6 MAIN CONTROL SWITCHBOARD
- 7 BATTERIES AND RACKS
- 8 AC AND DC SWITCHBOARD AND BATTERY CHARGER CUBICLE
- 9 OIL PRESSURE TANK
- 10 OIL SUMP TANK WITH OIL PUMP SETS
- 11 NGR CUBICLE
- 12 AVR CUBICLE
- 13 GENERATOR DISCONNECTING SWITCH CUBICLE
- 14 MAIN TRANSFORMER
- 15 SWITCHYARD FENCE
- 16 TAKE OFF STRUCTURE

SYMBOLS :

- ∞ EXHAUST FAN Ø10"
- ⊠ AIR CONDITIONING
- ⌞ EMERGENCY LAMP

FLOOR FINISH SYMBOLS :

- 1 COARSE FINISHED
- 2 12"x12" CERAMIC FLOOR TILES
- 3 COATED WITH EPOXY RESIN

WALL FINISH SYMBOLS :

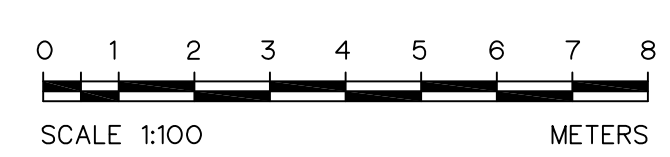
- 1 CEMENT PLASTER
- 2 8"x8" CERAMIC WALL TILES

NOTES :

- 1. ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
- 2. SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
- 3. CONTRACT C1 OF INCLUDE PENSTOCK BEYOND POWERHOUSE WALL 1.00 M. (INCLUDE FLANGE)
- 4. ALL OF CABLE TRENCH TYPE "C" (INCLUDE INSIDE SWITCHYARD FENCE) SHALL BE DONE BY CONTRACT C1.

REFERENCE DRAWINGS :

- 1. POWERHOUSE, GENERAL LAY-OUT HLS-PH-01
- 2. POWERHOUSE, ELEVATIONS HLS-PH-03
- 3. POWERHOUSE, SECTIONS HLS-PH-04



|     |      |           |         |          |
|-----|------|-----------|---------|----------|
| 3   |      |           |         |          |
| 2   |      |           |         |          |
| 1   |      |           |         |          |
| NO. | DATE | REVISIONS | CHECKED | APPROVED |
|     |      |           |         |          |

KINGDOM OF THAILAND

Department of Alternative  
Energy Development and Efficiency

MINISTRY OF ENERGY

HUAI LAM SIN HYDROPOWER PROJECT

CIVIL WORKS

POWERHOUSE

PLAN AND ROOF PLAN

FRONTIER ENGINEERING CONSULTANTS CO.,LTD.

REVIEWED S.KITIKHAJ

DESIGNED ๑๒๑.6651

SUBMITTED

DRAWN ๑๒๑.7324

RECOMMENDED

CHECKED ๑๒๑.7324

APPROVED

CONSULTANTS

DEDE

14/01/62

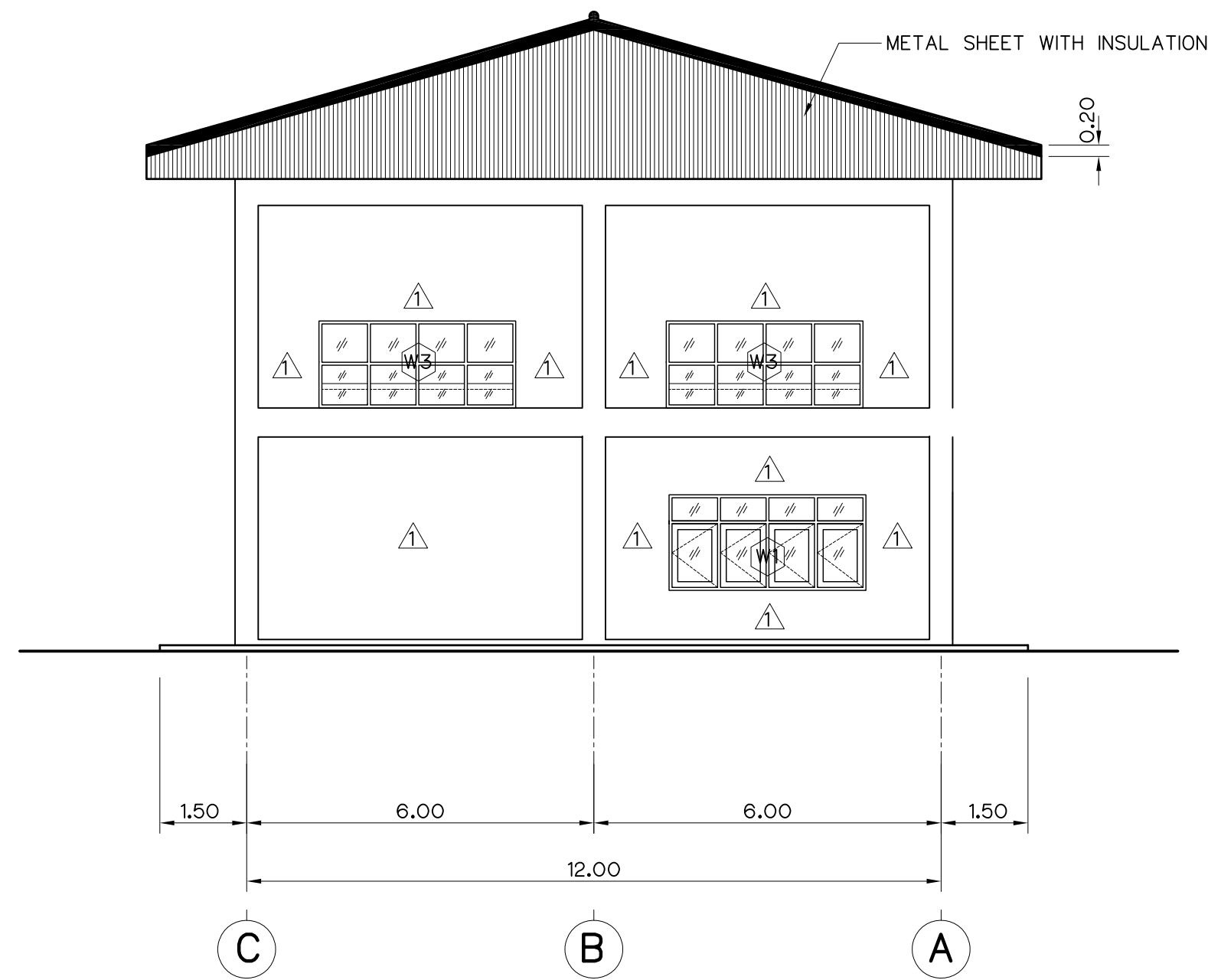
DATE

DRAWING NO.

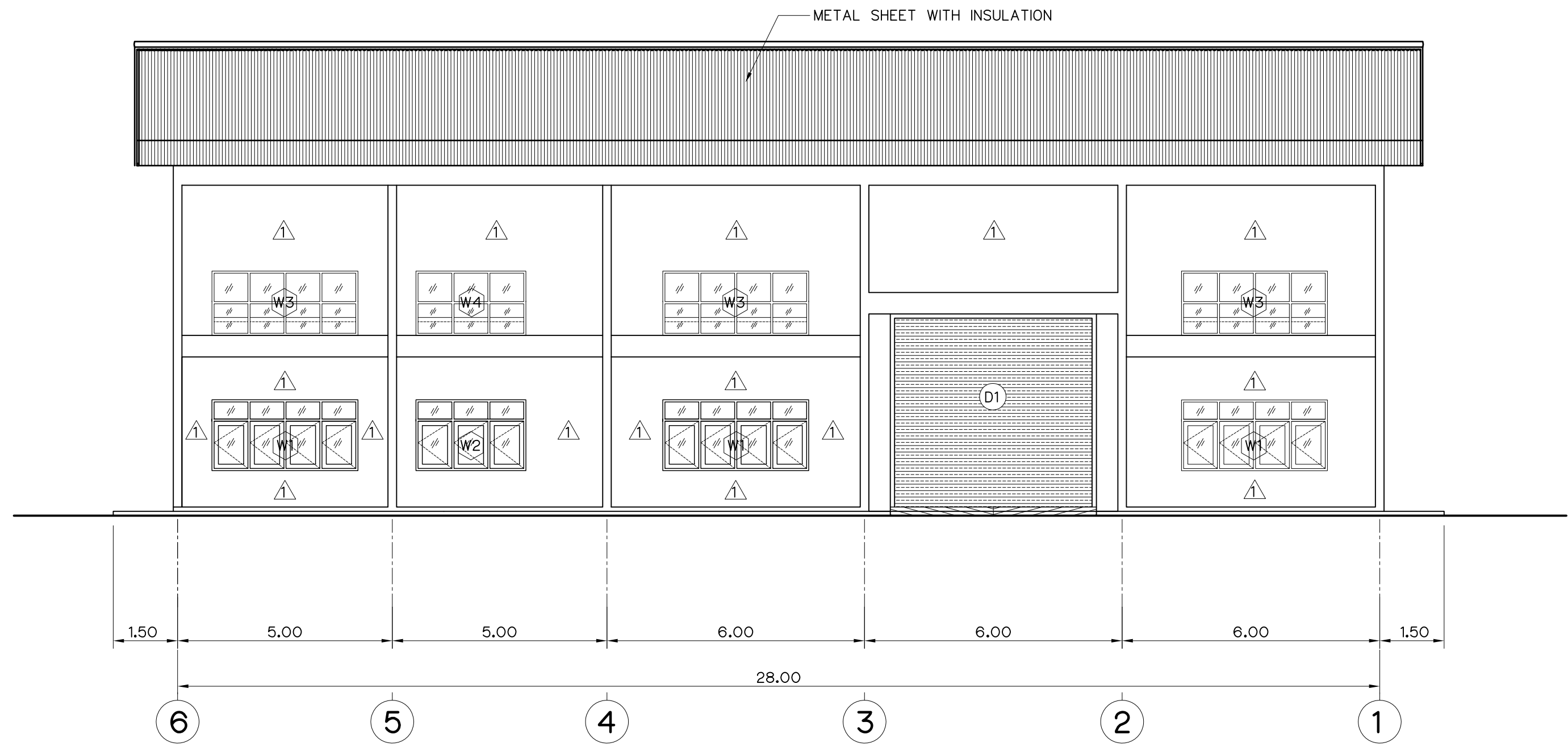
HLS-PH-02

SHEET NO.

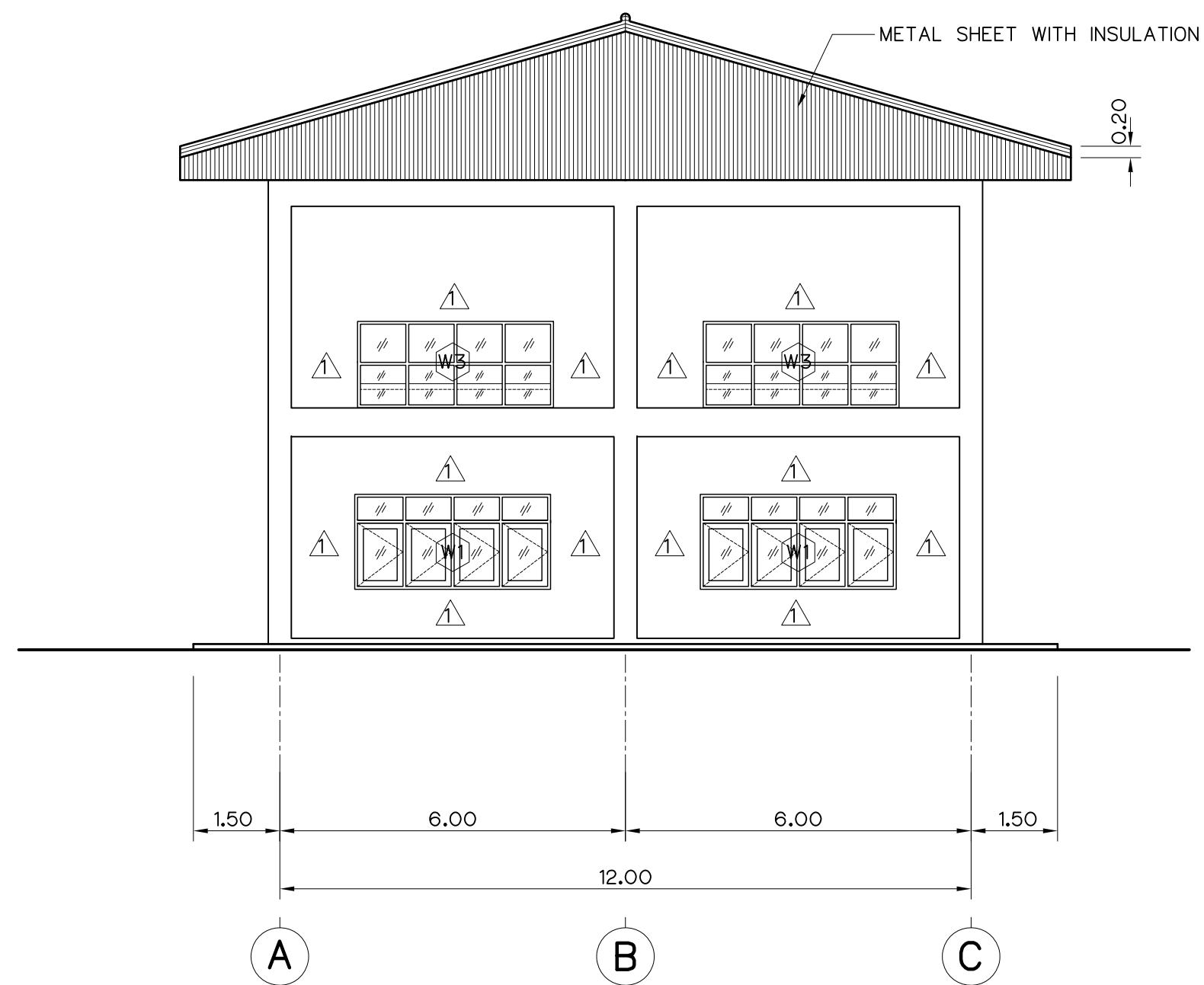
14 OF 25



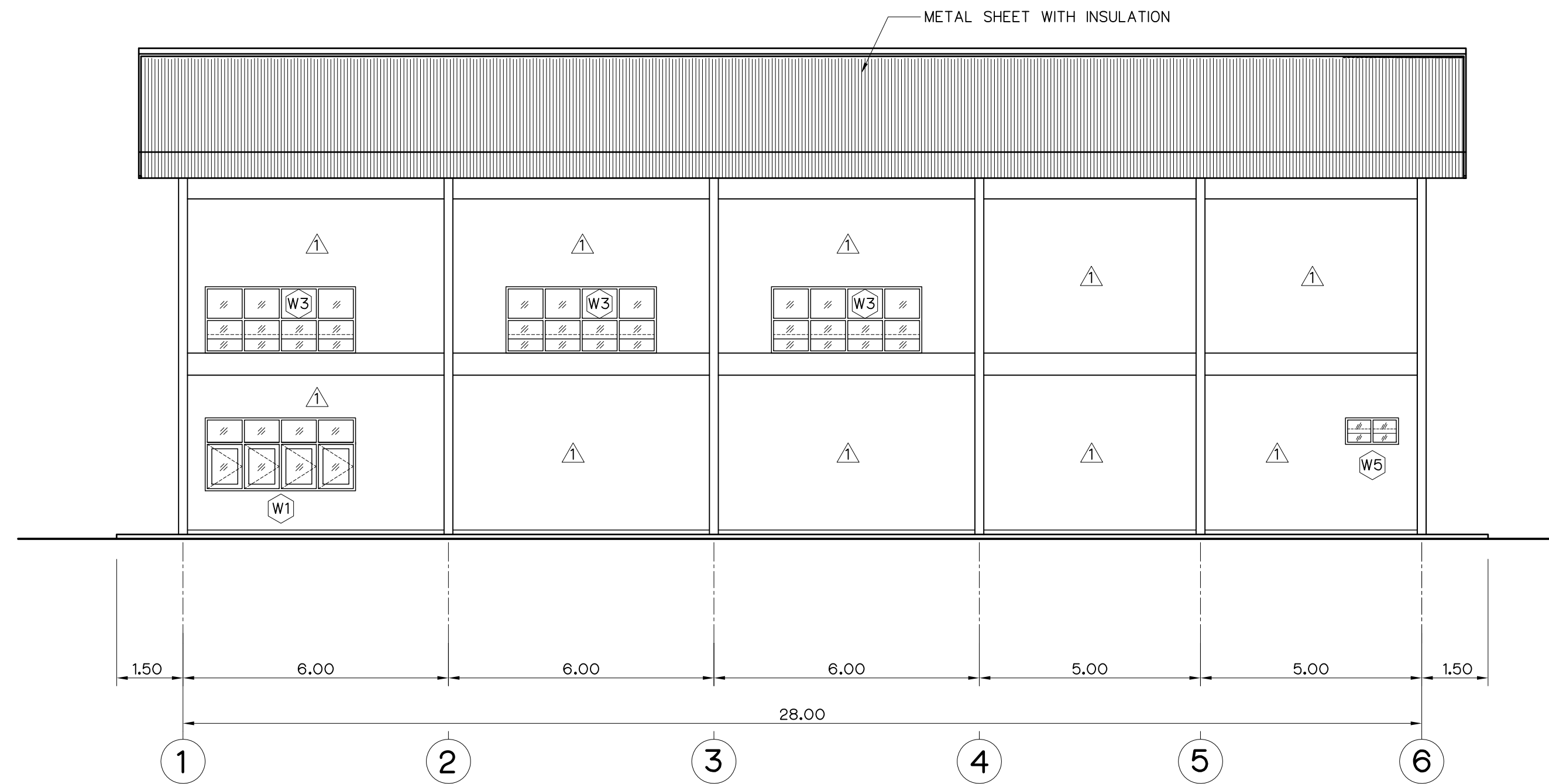
ELEVATION "A"  
SCALE 1:100



ELEVATION "B"  
SCALE 1:100



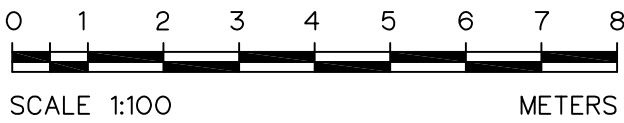
ELEVATION "C"  
SCALE 1:100



ELEVATION "D"  
SCALE 1:100

- NOTES :
- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
  - SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03

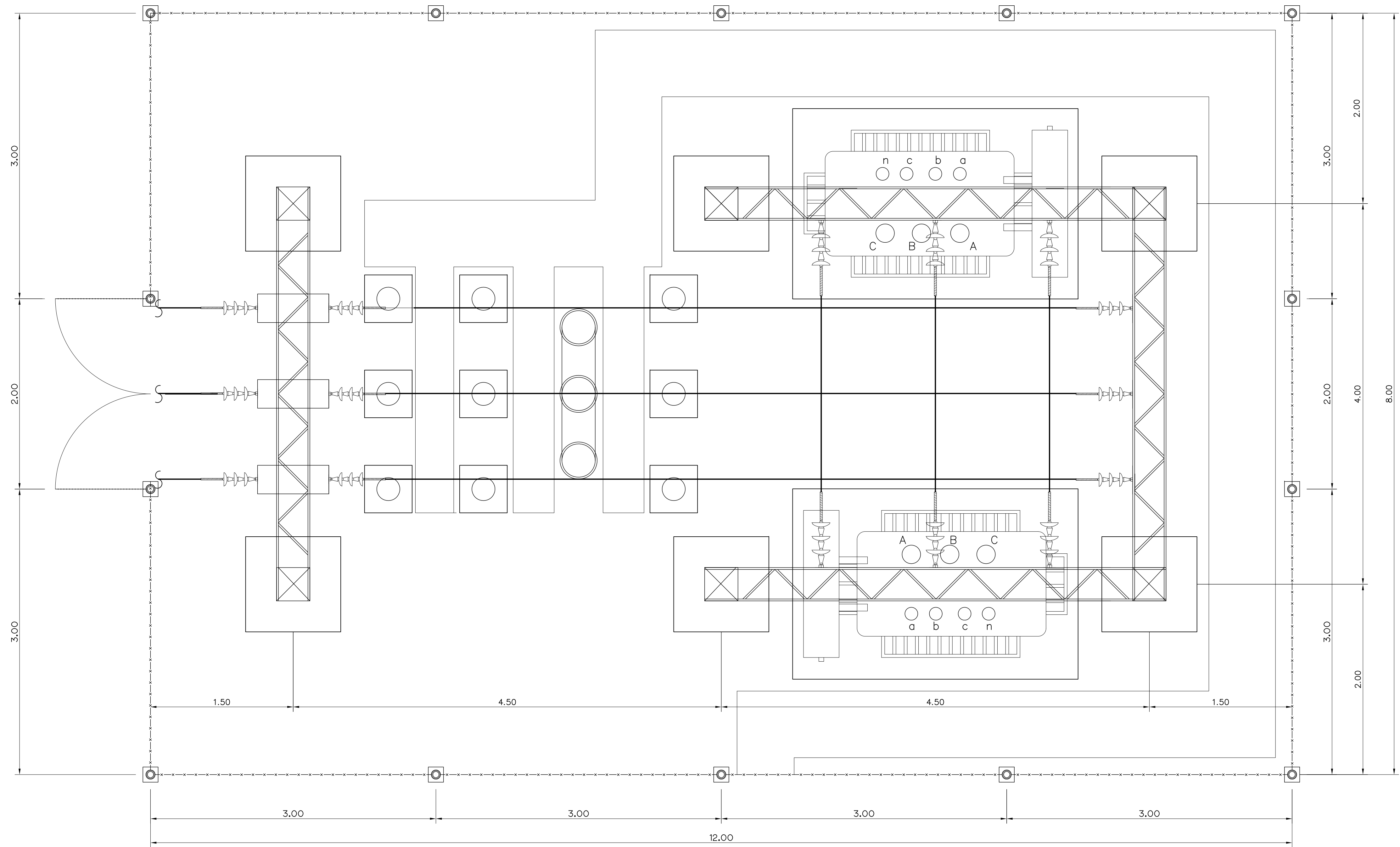
- REFERENCE DRAWINGS :
- |                                   |           |
|-----------------------------------|-----------|
| 1. POWERHOUSE, PLAN ANG ROOF PLAN | HLS-PH-02 |
| 2. POWERHOUSE, SECTIONS           | HLS-PH-04 |



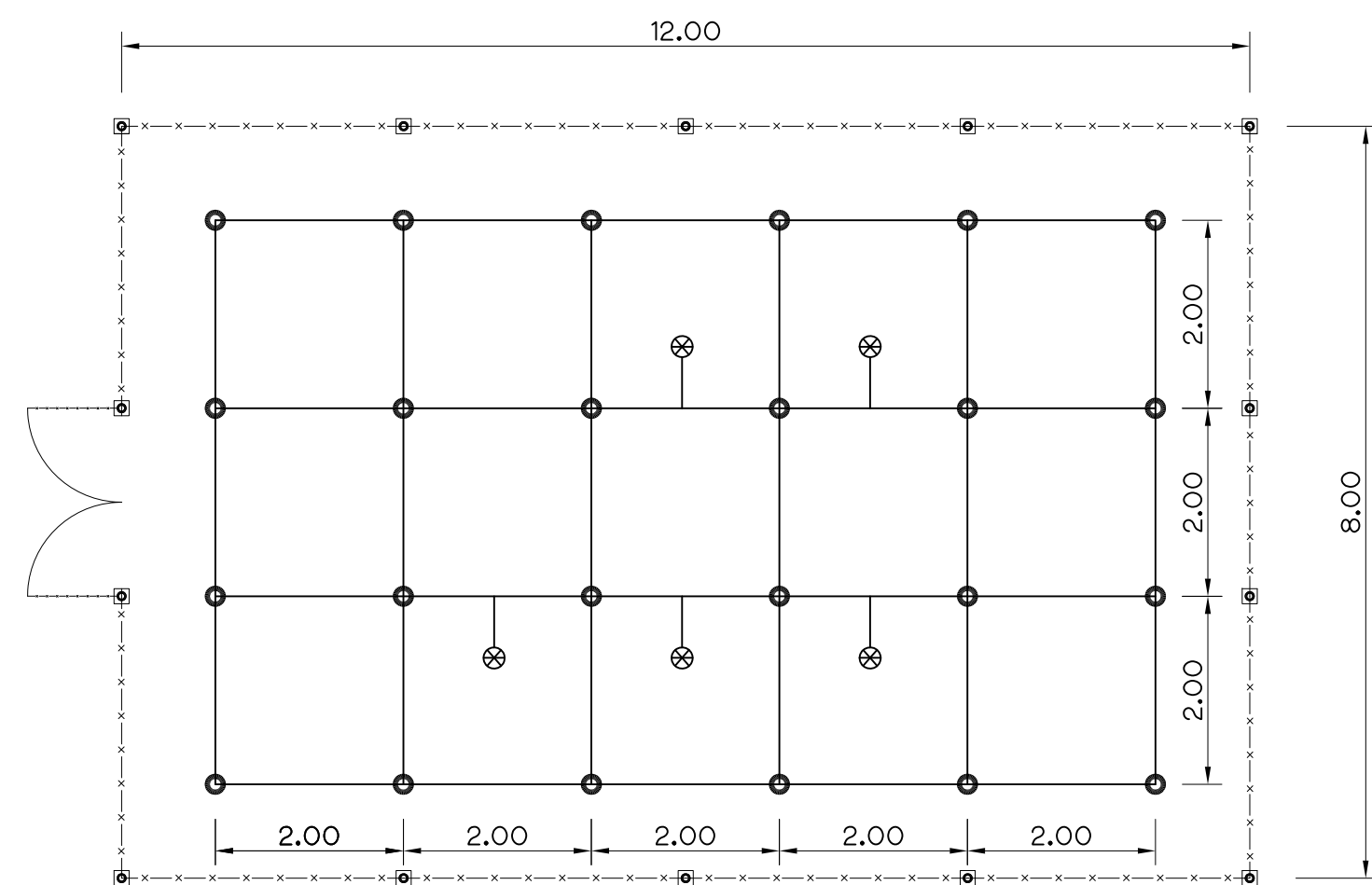
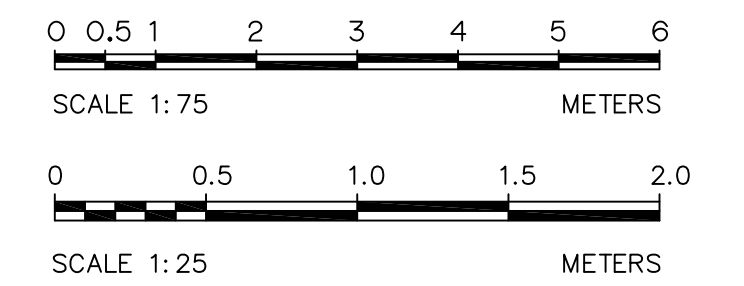
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|     |      |             |         |          |
|     |      | CONSULTANTS |         | DEDE     |

|                                                                                                             |                                                                                      |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                                                                                      |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                             |                                                                                      |
| CIVIL WORKS<br>POWERHOUSE<br>ELEVATIONS                                                                     |                                                                                      |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   | Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| DESIGNED ๑๒๑.6651                                                                                           | REVIEWED ๑๒๑.๖๖๕๑                                                                    |
| DRAWN ๑๒๑.๖๖๕๑                                                                                              | SUBMITTED ๑๒๑.๖๖๕๑                                                                   |
| CHECKED ๑๒๑.๖๖๕๑                                                                                            | RECOMMENDED ๑๒๑.๖๖๕๑                                                                 |
| APPROVED ๑๒๑.๖๖๕๑                                                                                           | APPROVED ๑๒๑.๖๖๕๑                                                                    |
| PROJECT MANAGER ๑๒๑.๖๖๕๑                                                                                    | DATE 14/01/62                                                                        |
| DRAWING NO. HLS-PH-03                                                                                       | SHEET NO. 15 OF 25                                                                   |





PLAN  
SCALE 1:25



GROUNDING SYSTEM  
SCALE 1:75

NOTES :

1. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE SHOWN.
2. SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
3. THE TRANSFORMER YARD WILL BE ACCORDING TO PEA STANDARD.
4. GROUNDING CONDUCTOR, TAP AND RISER FROM GROUNDING NETWORK TO POWER EQUIPMENT SHALL BE FORMED BY BARE COPPER CONDUCTOR NOT LESS THAN 95 SQ.MM.
5. GROUNDING SYSTEM RESISTANCE WILL NOT EXCEED 5 OHM.
6. CONNECTOR TO WITH IN & BETWEEN THE GROUNDING NETWORK TO POWER PLANT EQUIPMENT WILL BE MADE BY THERMAL CADWELD
7. GROUND ROD WILL BE COPPER COVER STEEL DIAMETER 15.87 MM. 2,400 MM. LONG
8. THIS DRAWING USE FOR GUIDE ONLY

REFERENCE DRAWINGS :

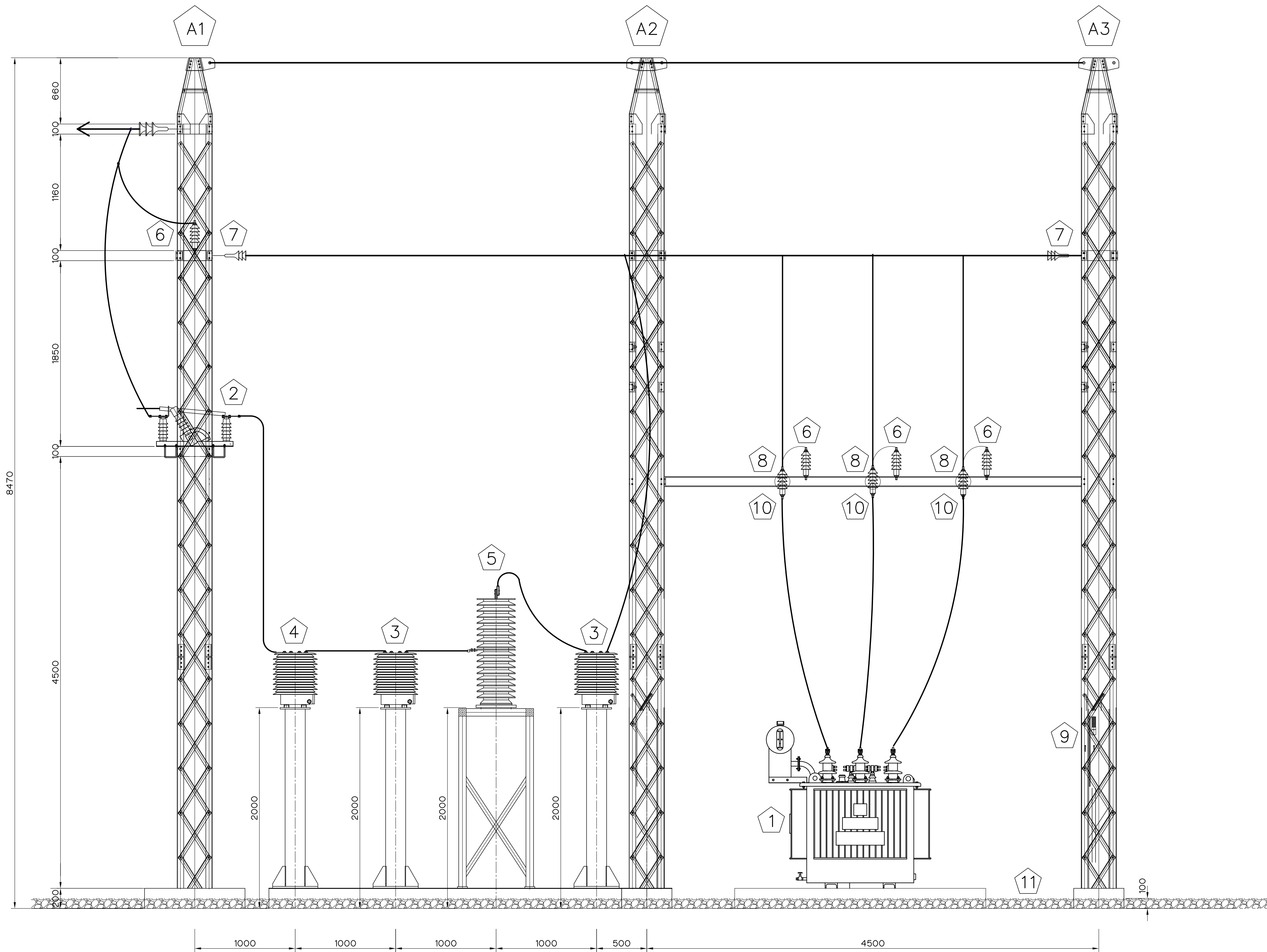
1. POWERHOUSE, TRANSFORMER AND SWITCHYARD, SECTIONS HLS-PH-06
2. POWERHOUSE, TRANSFORMER AND SWITCHYARD, DETAILS HLS-PH-07

LEGENDS :

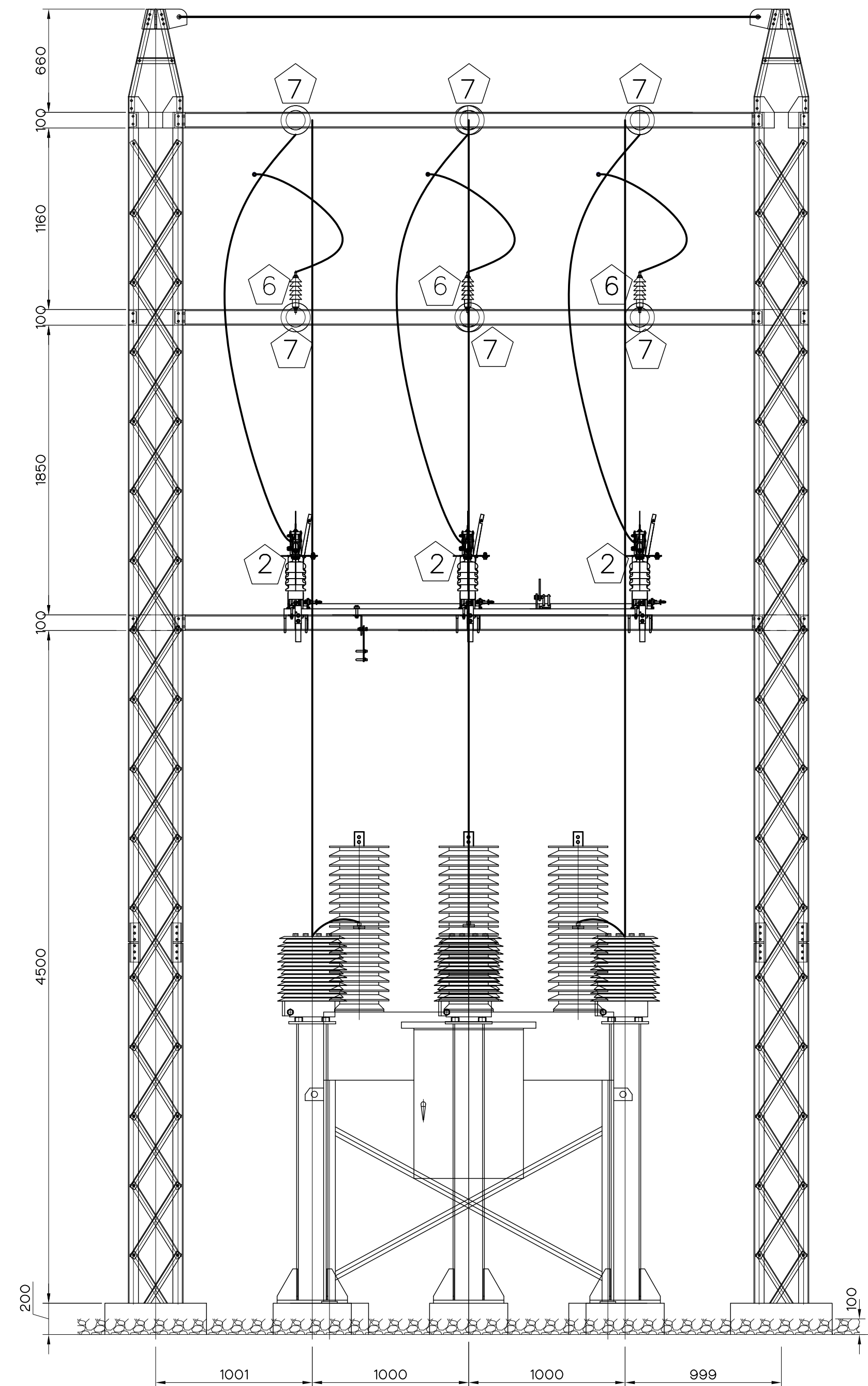
- GROUND ROD
- ⊗ GROUND POINT FOR POWER PLANT EQUIPMENT GROUNDING
- BARE CUPPER CONDUCTOR

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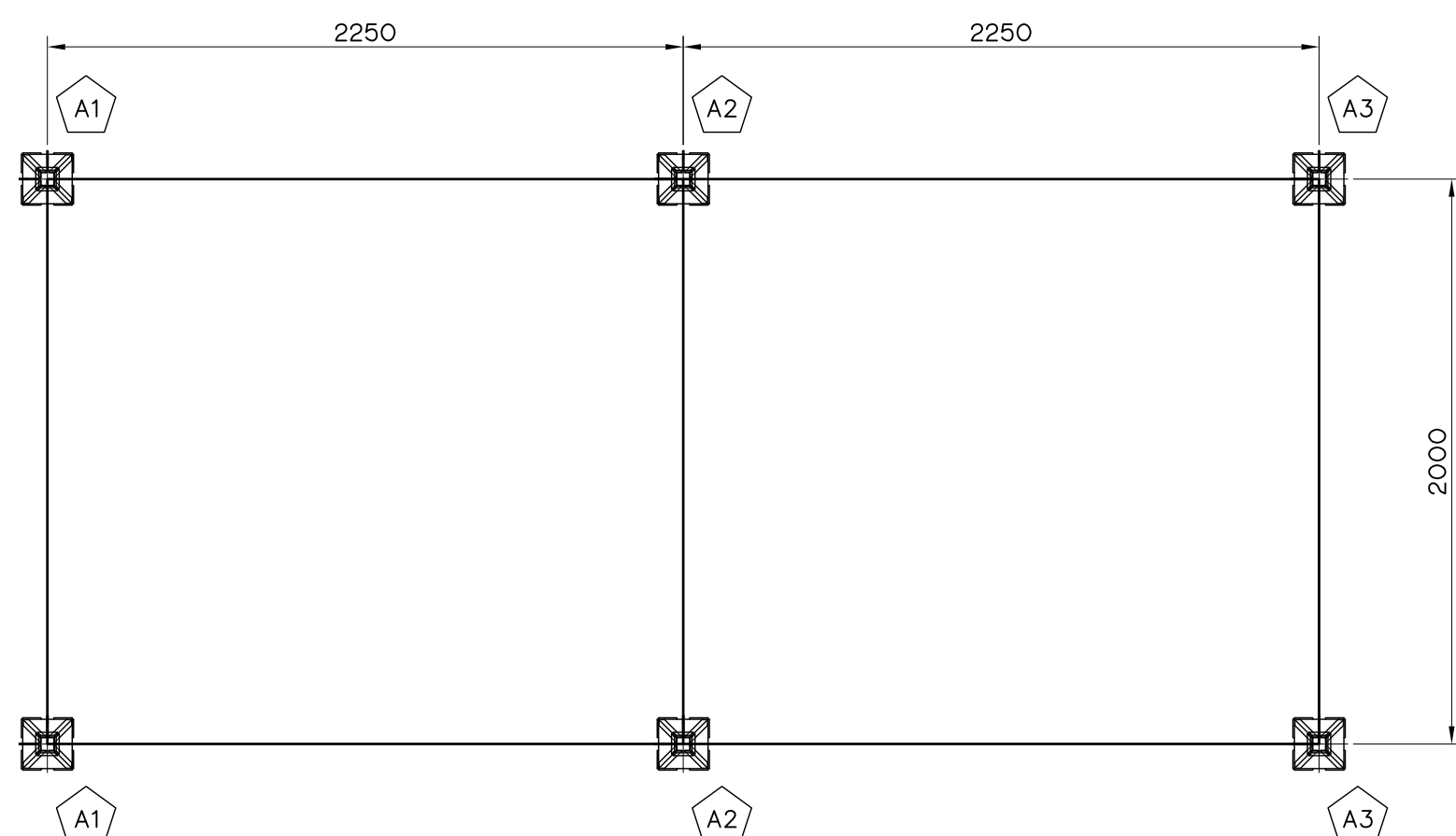
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|-------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                                             |
| HUA LAM SIN HYDROPOWER PROJECT                                                                              |                                             |
| CIVIL WORKS<br>POWERHOUSE<br>TRANSFORMER, SWITCHYARD AND GROUNDING SYSTEM                                   |                                             |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   | REVIEWED S.KITIKHAJ                         |
| DESIGNED <i>[Signature]</i> 21/11/1029                                                                      | SUBMITTED <i>[Signature]</i>                |
| DRAWN <i>[Signature]</i>                                                                                    | RECOMMENDED <i>[Signature]</i>              |
| CHECKED <i>[Signature]</i> 21/11/1029                                                                       | APPROVED <i>[Signature]</i>                 |
| PROJECT MANAGER <i>[Signature]</i> 14/01/62<br>DATE                                                         | DRAWING NO. HLS-PH-05<br>SHEET NO. 17 OF 25 |



SIDE VIEW  
SCALE 1:25



FRONT VIEW  
SCALE 1:25

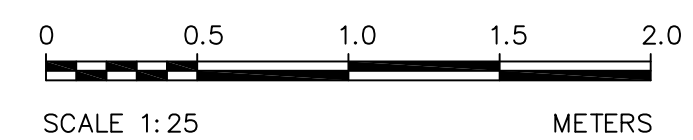


OVERHEAD GROUND WIRE PLAN  
SCALE 1:50

| ITEM. | DESCRIPTION                        | Q'TY. | REMARK. |
|-------|------------------------------------|-------|---------|
| 1     | MAIN TRANSFORMER 33000/400 V.      | 2     |         |
| 2     | DISCONNECTING SWITCH               | 1     |         |
| 3     | OUTDOOR CURRENT TRANSFORMERS RATIO | 6     |         |
| 4     | OUTDOOR VOLTGE TRANSFORMER RATIO   | 3     |         |
| 5     | SF6 CIRCUIT-BREAKER (VCB1)         | 1     |         |
| 6     | SURGE ARRESTERS                    | 9     |         |
| 7     | SUSPENSION INSULATORS              | 45    |         |
| 8     | LINE POST INSULATORS               | 6     |         |
| 9     | LINE GROUND SWITCH                 | 2     |         |
| 10    | 33 KV. DROP OUT FUSE               | 6     |         |
| 11    | GRAVEL                             | 1     |         |

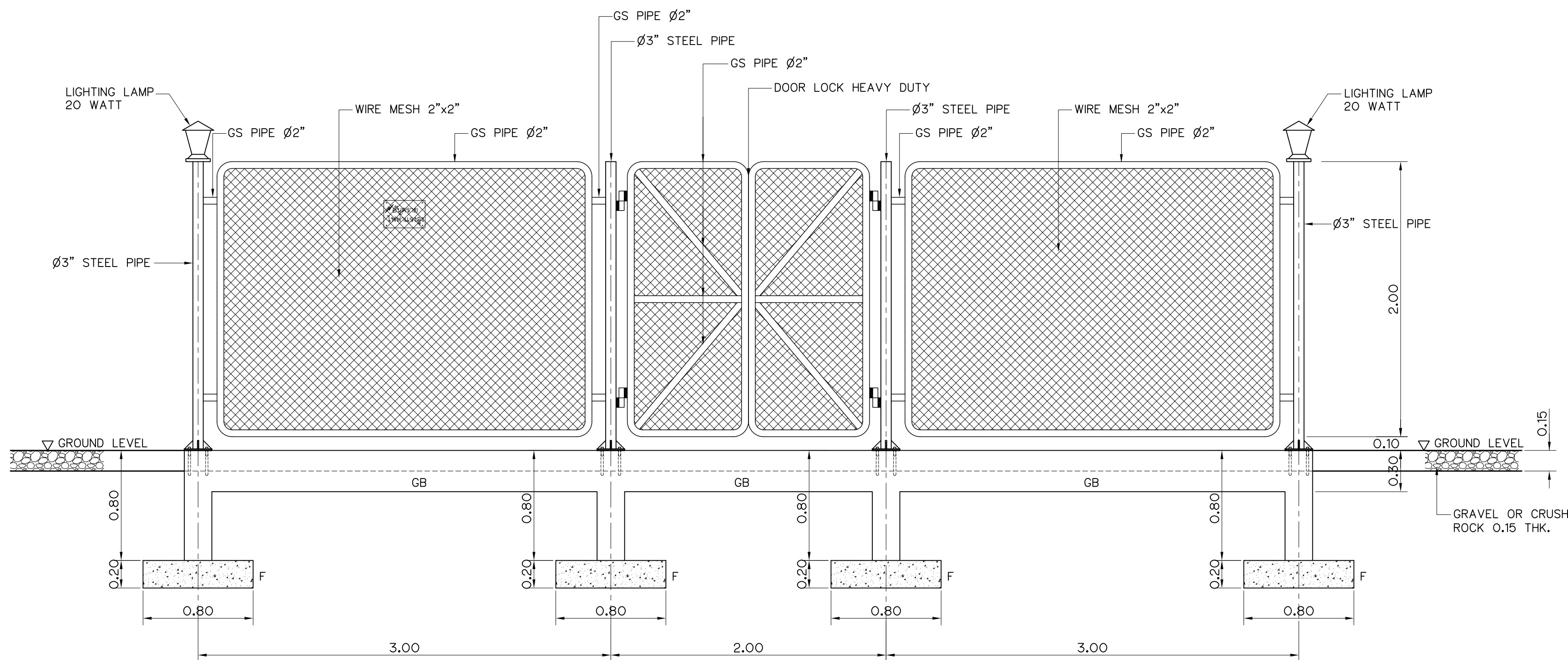
- NOTES :
- ALL DIMENSIONS ARE IN MILLIMETERS, UNLESS OTHERWISE SHOWN.
  - SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
  - THE TRANSFORMER YARD WILL BE ACCORDING TO PEA STANDARD.

- REFERENCE DRAWINGS :
- POWERHOUSE, TRANSFORMER, SWITCHYARD AND GROUNDING SYSTEM HLS-PH-05
  - POWERHOUSE, TRANSFORMER AND SWITCHYARD, DETAILS HLS-PH-07

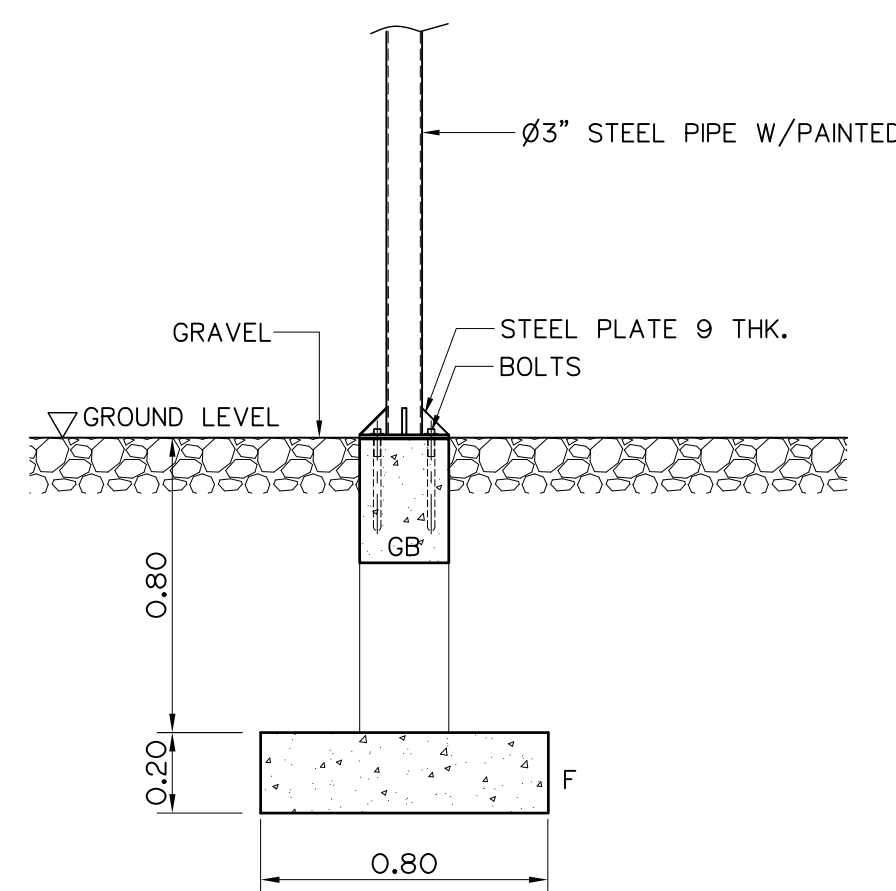


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| NO.         | DATE | REVISIONS | CHECKED | APPROVED |
| CONSULTANTS |      | DEDE      |         |          |

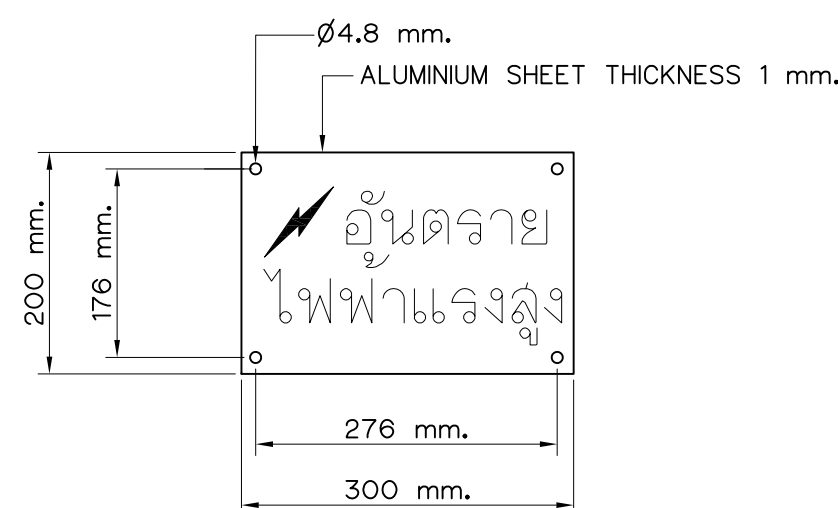
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|-------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                                             |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                             |                                             |
| CIVIL WORKS<br>POWERHOUSE<br>TRANSFORMER AND SWITCHYARD, SECTIONS                                           |                                             |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   | REVIEWED S.KITICHAJ                         |
| DESIGNED <i>[Signature]</i> 27/11/029                                                                       | SUBMITTED <i>[Signature]</i>                |
| DRAWN <i>[Signature]</i>                                                                                    | RECOMMENDED <i>[Signature]</i>              |
| CHECKED <i>[Signature]</i> 27/11/029                                                                        | APPROVED <i>[Signature]</i>                 |
| <i>[Signature]</i> 14/01/62<br>PROJECT MANAGER DATE                                                         | DRAWING NO. HLS-PH-06<br>SHEET NO. 18 OF 25 |



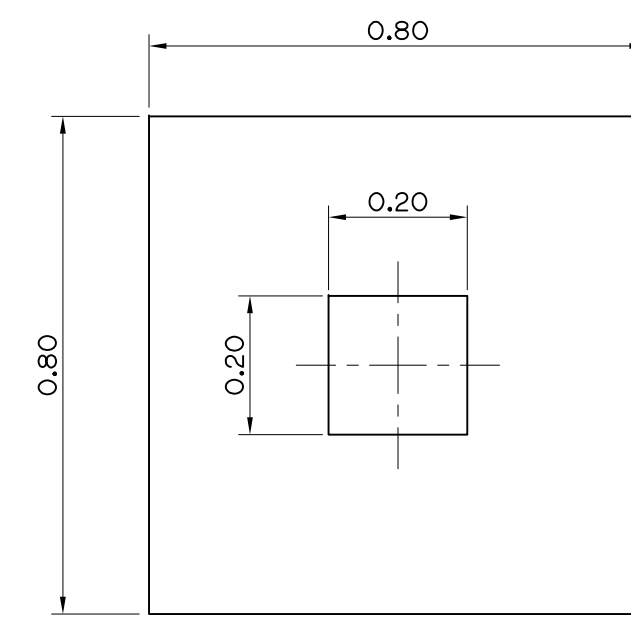
FENCE DETAIL  
NOT TO SCALE



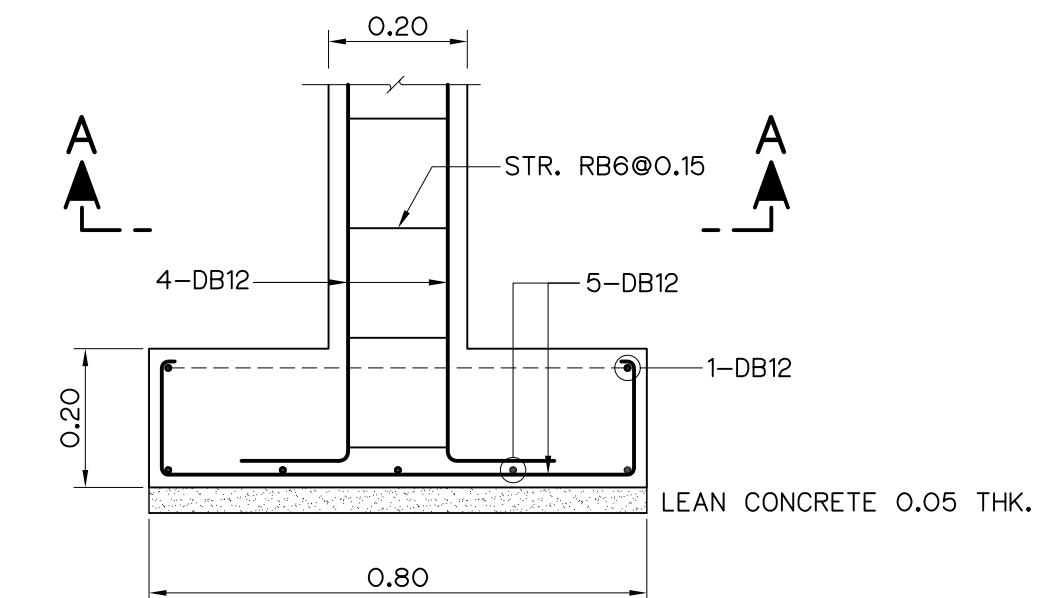
DETAIL OF FOOTING (F)  
NOT TO SCALE



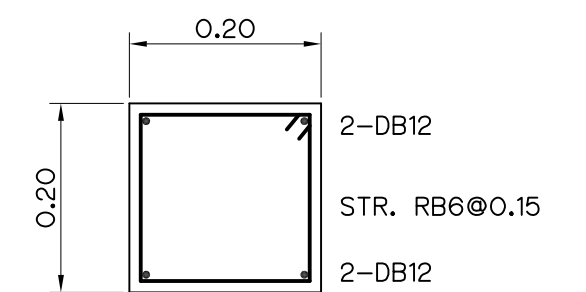
WARNING SIGN  
NOT TO SCALE



REINFORCEMENT OF FOOTING (F)  
NOT TO SCALE



REINFORCEMENT OF BEAM (GB)  
NOT TO SCALE



SECTION A-A  
NOT TO SCALE

NOTES :

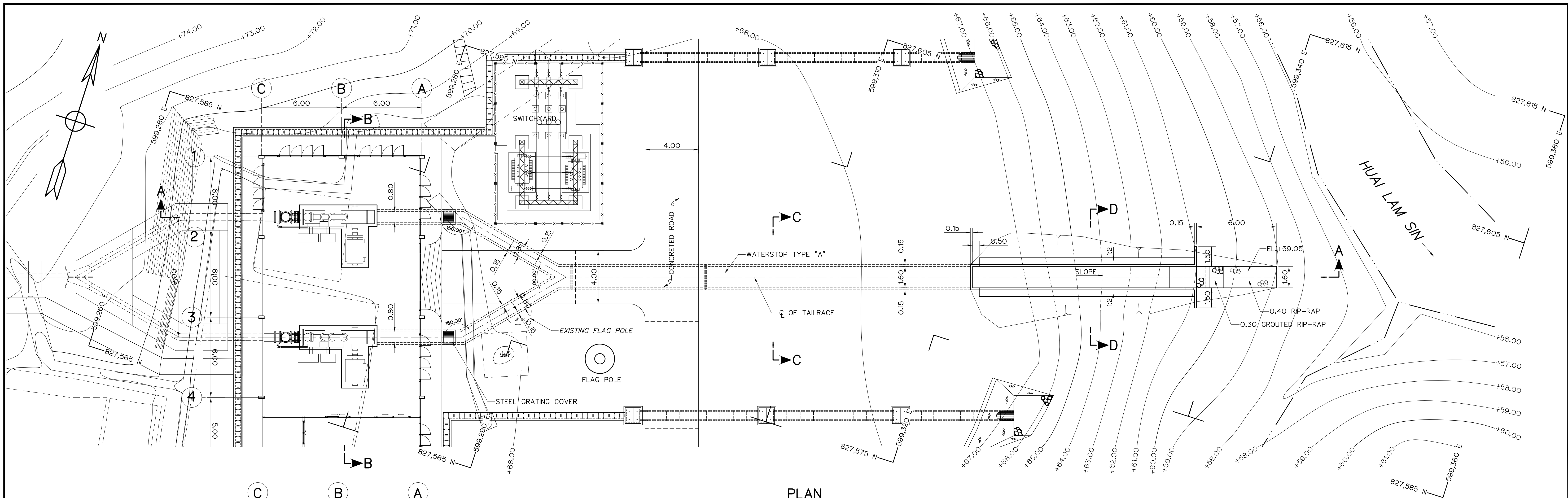
1. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE SHOWN.
2. SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
3. THE TRANSFORMER YARD WILL BE ACCORDING TO PEA STANDARD.

REFERENCE DRAWINGS :

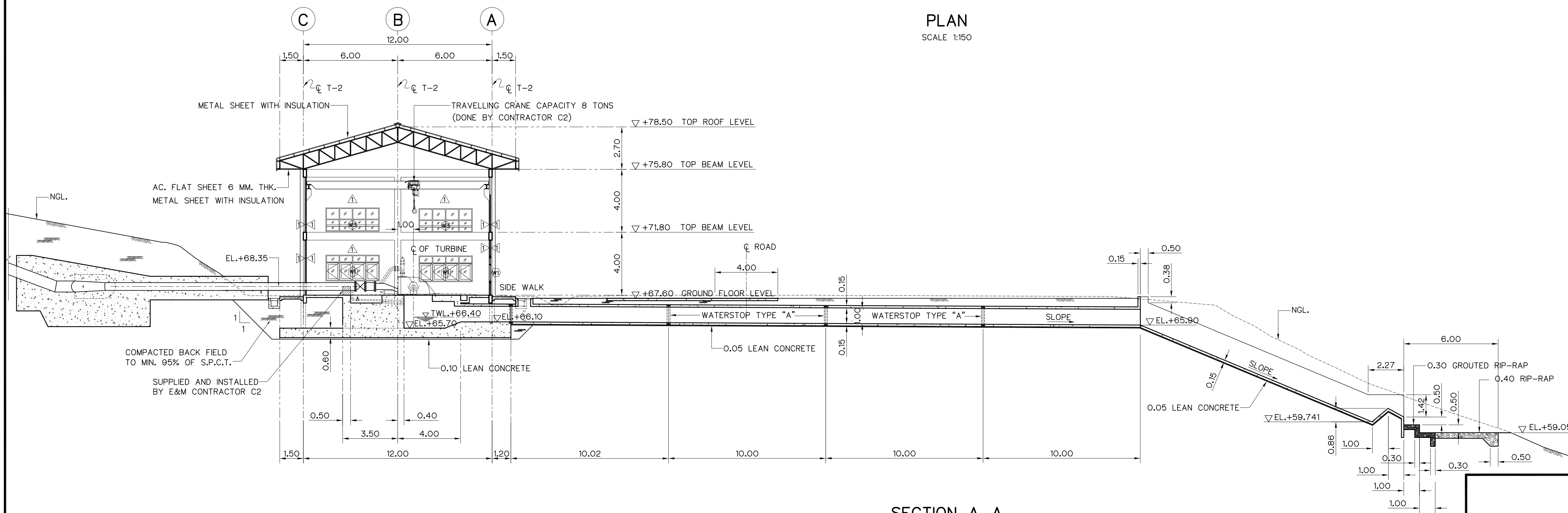
1. POWERHOUSE, TRANSFORMER, SWITCHYARD AND GROUNDING SYSTEM HLS-PH-05
2. POWERHOUSE, TRANSFORMER AND SWITCHYARD, SECTIONS HLS-PH-06

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| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                       |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                             |                       |
| CIVIL WORKS<br>POWERHOUSE<br>TRANSFORMER AND SWITCHYARD, DETAILS                                            |                       |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   | REVIEWED S.KTICHAJ    |
| DESIGNED ๖๒.6651                                                                                            | SUBMITTED ๖๒.6651     |
| DRAWN ๖๒.6651                                                                                               | RECOMMENDED ๖๒.6651   |
| CHECKED ๖๒.6651                                                                                             | APPROVED ๖๒.6651      |
| PROJECT MANAGER ๖๒.6651                                                                                     | DRAWING NO. HLS-PH-07 |
| DATE 14/01/62                                                                                               | SHEET NO. 19 OF 25    |



PLAN  
SCALE 1:150



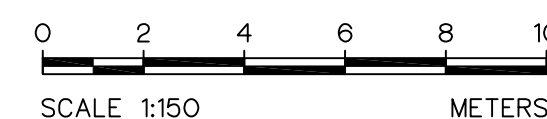
SECTION A-A  
SCALE 1:150

NOTES :

- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
- SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
- TURBINE & GENERATOR FOUNDATIONS, TRENCH AND BLOCKOUT SIZES AND LOCATIONS ARE ONLY APPROXIMATE. THE ELECTRO-MECHANICAL CONTRACTOR IS REQUIRED TO SUBMIT THE SHOP DRAWINGS INDICATED ALL FINAL SIZES AND LOCATIONS TO FIELD ENGINEER

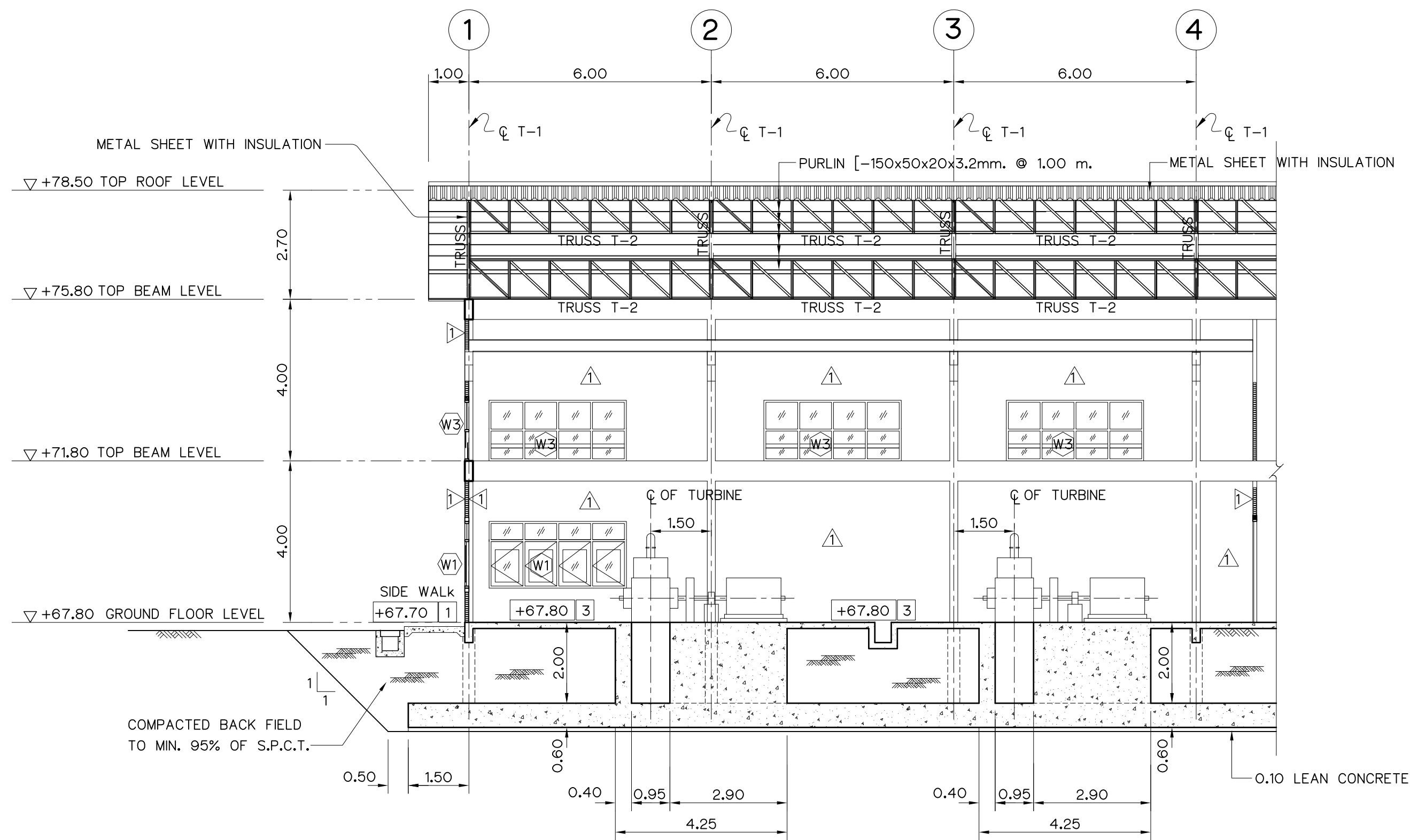
REFERENCE DRAWINGS :

- TAILRACE, SECTIONS B-B, C-C AND D-D HLS-TR-02

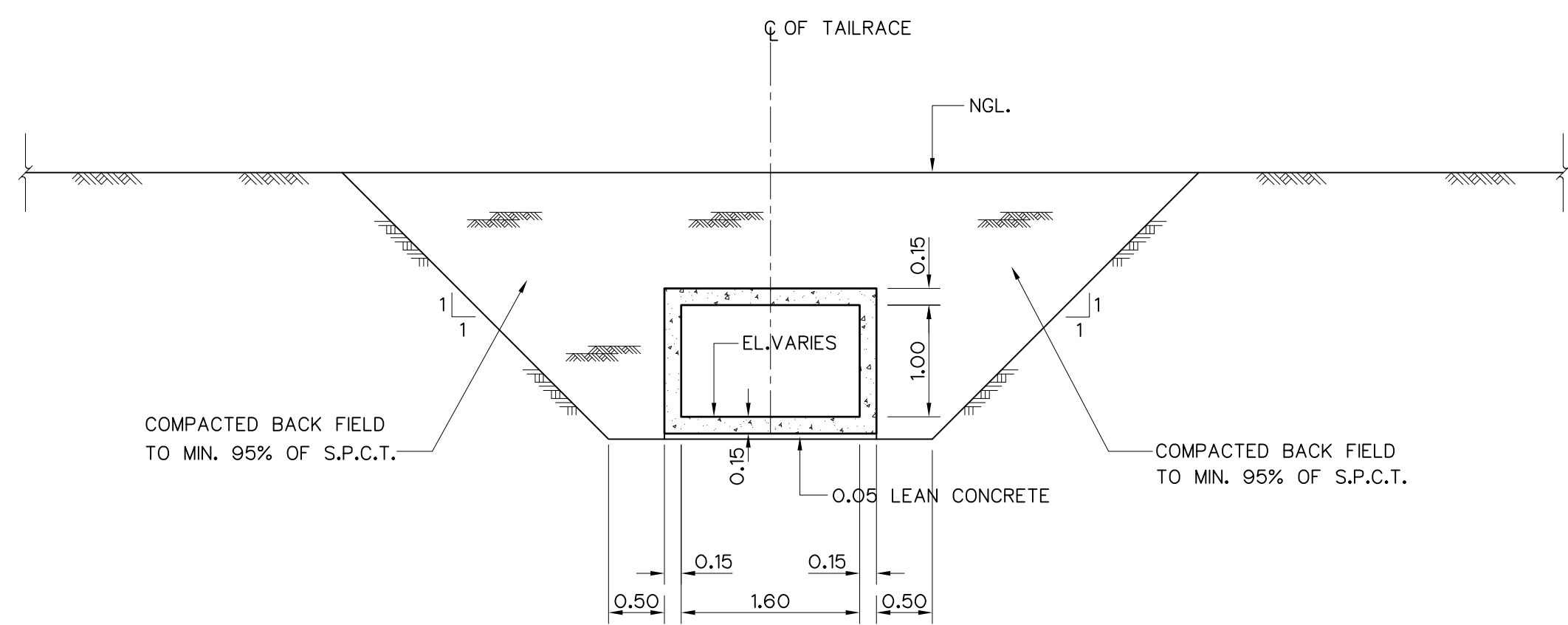


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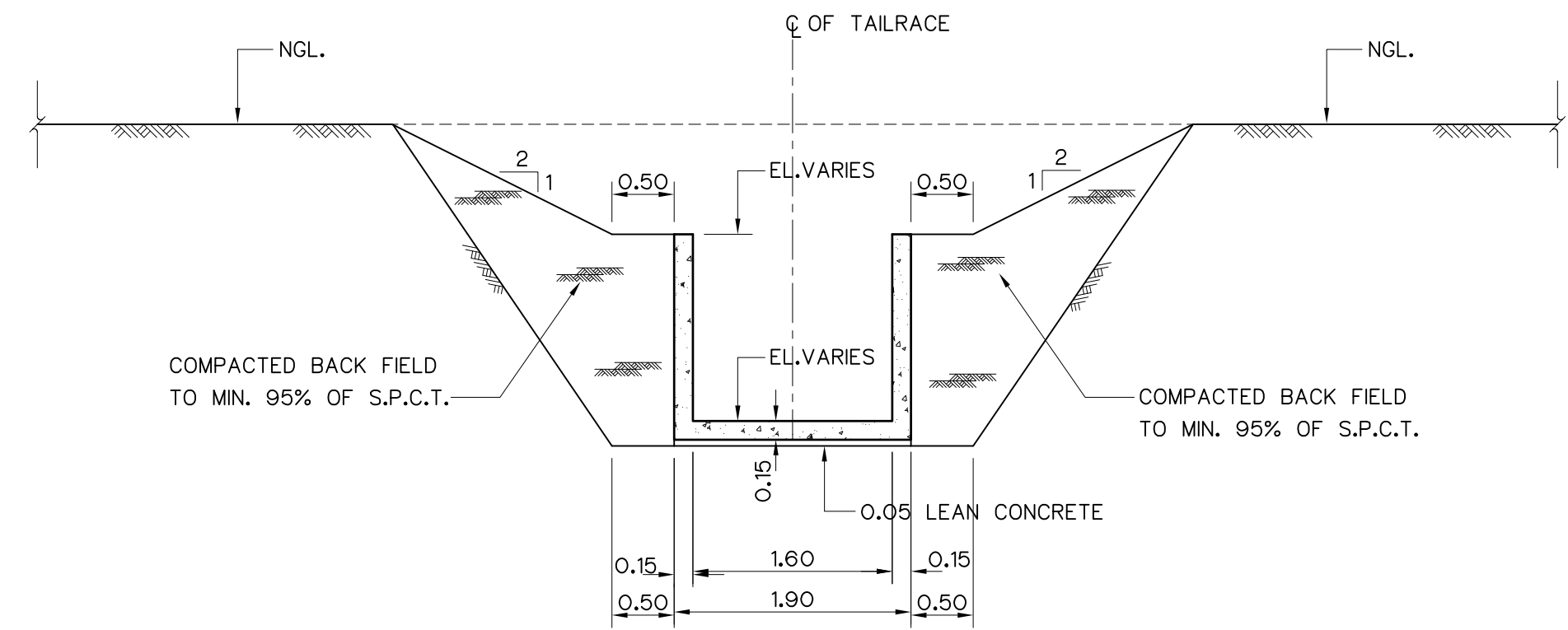
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| KINGDOM OF THAILAND<br>Department of Alternative<br>Energy Development and Efficiency<br>MINISTRY OF ENERGY |                       |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                             |                       |
| CIVIL WORKS<br>TAILRACE<br>PLAN AND SECTION A-A                                                             |                       |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                   | REVIEWED S.KITIKHAJ   |
| DESIGNED ๒๒.๖๕1                                                                                             | SUBMITTED             |
| DRAWN ๒๒.๖๕1                                                                                                | RECOMMENDED           |
| CHECKED ๒๒.๖๕1                                                                                              | APPROVED              |
| PROJECT MANAGER 14/01/62                                                                                    | DRAWING NO. HLS-TR-01 |
| DATE                                                                                                        | SHEET NO. 20 OF 25    |



SECTION B-B  
SCALE 1:100



SECTION C-C  
SCALE 1:50



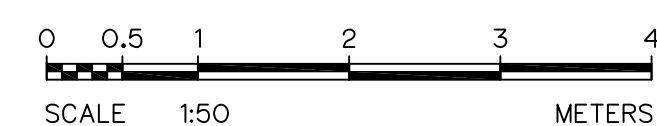
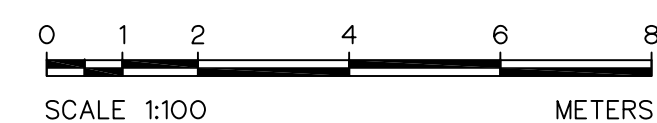
SECTION D-D  
SCALE 1:50

#### NOTES :

- ALL DIMENSIONS AND ELEVATIONS (M.S.L.) ARE IN METERS, UNLESS OTHERWISE SHOWN.
- SYMBOLS, ABBREVIATIONS AND GENERAL NOTES SEE DWG. NO. HLS-GN-03
- TURBINE & GENERATOR FOUNDATIONS, TRENCH AND BLOCKOUT SIZES AND LOCATIONS ARE ONLY APPROXIMATE. THE ELECTRO-MECHANICAL CONTRACTOR IS REQUIRED TO SUBMIT THE SHOP DRAWINGS INDICATED ALL FINAL SIZES AND LOCATIONS TO FIELD ENGINEER

#### REFERENCE DRAWINGS :

- TAILRACE, PLAN AND SECTION HLS-TR-01

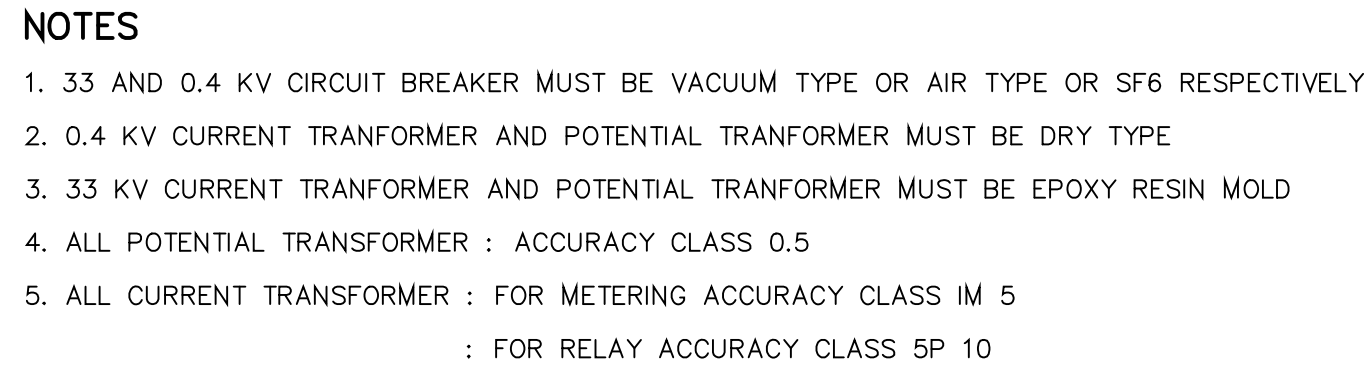


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CONSULTANTS

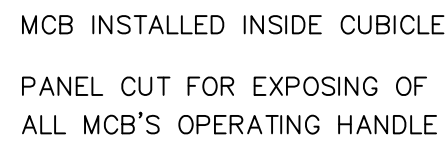
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| <p>KINGDOM OF THAILAND<br/>Department of Alternative<br/>Energy Development and Efficiency<br/>MINISTRY OF ENERGY</p> |                    |
| <p>HUAI LAM SIN HYDROPOWER PROJECT</p>                                                                                |                    |
| <p>CIVIL WORKS<br/>TAILRACE<br/>SECTIONS B-B, C-C AND D-D</p>                                                         |                    |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                             | REVIEWED S.KTICHAI |
| DESIGNED                                                                                                              | SUBMITTED          |
| DRAWN                                                                                                                 | RECOMMENDED        |
| CHECKED                                                                                                               | APPROVED           |
| PROJECT MANAGER                                                                                                       | DATE               |
| DRAWING NO.                                                                                                           | SHEET NO.          |
| HLS-TR-02                                                                                                             | 21 OF 25           |



| RELAY CODE | DESCRIPTION                                                      | COMMAND                                       |
|------------|------------------------------------------------------------------|-----------------------------------------------|
| 25         | RELAY SYNCHRONIZE                                                | CLOSE CIRCUIT CHECKING OF VCB 1, ACB 1, ACB 2 |
| 27/39      | UNDER VOLTAGE PROTECTION RELAY/OVER VOLTAGE PROTECTION RELAY     | TRIP COMMAND FOR VCB 1                        |
| 50/51      | OVER CURRENT PROTECTION RELAY                                    | TRIP COMMAND FOR VCB 1                        |
| 59N        | OVER VOLTAGE PROTECTION RELAY-NEUTRAL VOLTAGE TYPE               | TRIP COMMAND FOR VCB 1                        |
| 67         | OVER CURRENT PROTECTION RELAY-DIRECTION PHASE TYPE               | TRIP COMMAND FOR VCB 1                        |
| 81         | UNDER FREQUENCY PROTECTION RELAY/OVER FREQUENCY PROTECTION RELAY | TRIP COMMAND FOR VCB 1                        |
| 27R        | TRANSIENT UNDER VOLTAGE PROTECTION RELAY                         | CLOSE CIRCUIT PROTECTION FOR VCB 1            |
| 87T        | DIFFERENTIAL PROTECTION RELAY FOR TRANSFORMER                    | TRIP COMMAND FOR VCB 1 AND ACB 1&2            |
| 87G        | DIFFERENTIAL PROTECTION RELAY FOR GENERATOR                      | TRIP COMMAND FOR ACB 1&2                      |
| 78&81R     | ISLANDING POWER SUPPLY PROTECTION RELAY                          | TRIP COMMAND FOR VCB 1                        |
| 32         | POWER PROTECTION RELAY-DIRECTION TYPE                            | TRIP COMMAND FOR VCB 1                        |

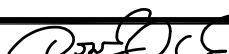
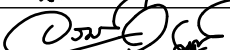
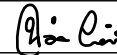
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|  <div style="text-align: center;"> <b>KINGDOM OF THAILAND</b><br/>             Department of Alternative<br/>             Energy Development and Efficiency<br/> <b>MINISTRY OF ENERGY</b> </div> |                        |                                                  |  |
| <h1>HUAI LAM SIN HYDROPOWER PROJECT</h1>                                                                                                                                                                                                                                               |                        |                                                  |  |
| <h2>CIVIL WORKS</h2>                                                                                                                                                                                                                                                                   |                        |                                                  |  |
| <h3>MAIN POWER SINGLE LINE DIAGRAM</h3>                                                                                                                                                                                                                                                |                        |                                                  |  |
|  <div style="text-align: center;">             Department of Alternative<br/>             Energy Development and Efficiency<br/> <b>MINISTRY OF ENERGY</b> </div>                                 |                        | <b>REVIEWED &amp; INITIAL</b> <i>[Signature]</i> |  |
| <b>FRONTIER ENGINEERING CONSULTANTS CO., LTD.</b>                                                                                                                                                                                                                                      |                        | <b>REVIEWED</b> <i>[Signature]</i>               |  |
| <b>DESIGNED</b> <i>[Signature]</i>                                                                                                                                                                                                                                                     | <b>DATE</b> 27/11/1029 | <b>APPROVED</b> <i>[Signature]</i>               |  |
| <b>DRAWN</b> <i>[Signature]</i>                                                                                                                                                                                                                                                        | <b>DATE</b> 27/11/1029 | <b>SHEET NO.</b>                                 |  |
| <b>CHECKED</b> <i>[Signature]</i>                                                                                                                                                                                                                                                      | <b>DATE</b> 27/11/1029 | <b>22 OF 25</b>                                  |  |
| <b>PROJECT MANAGER</b>                                                                                                                                                                                                                                                                 |                        | <b>HLS-EM-01</b>                                 |  |

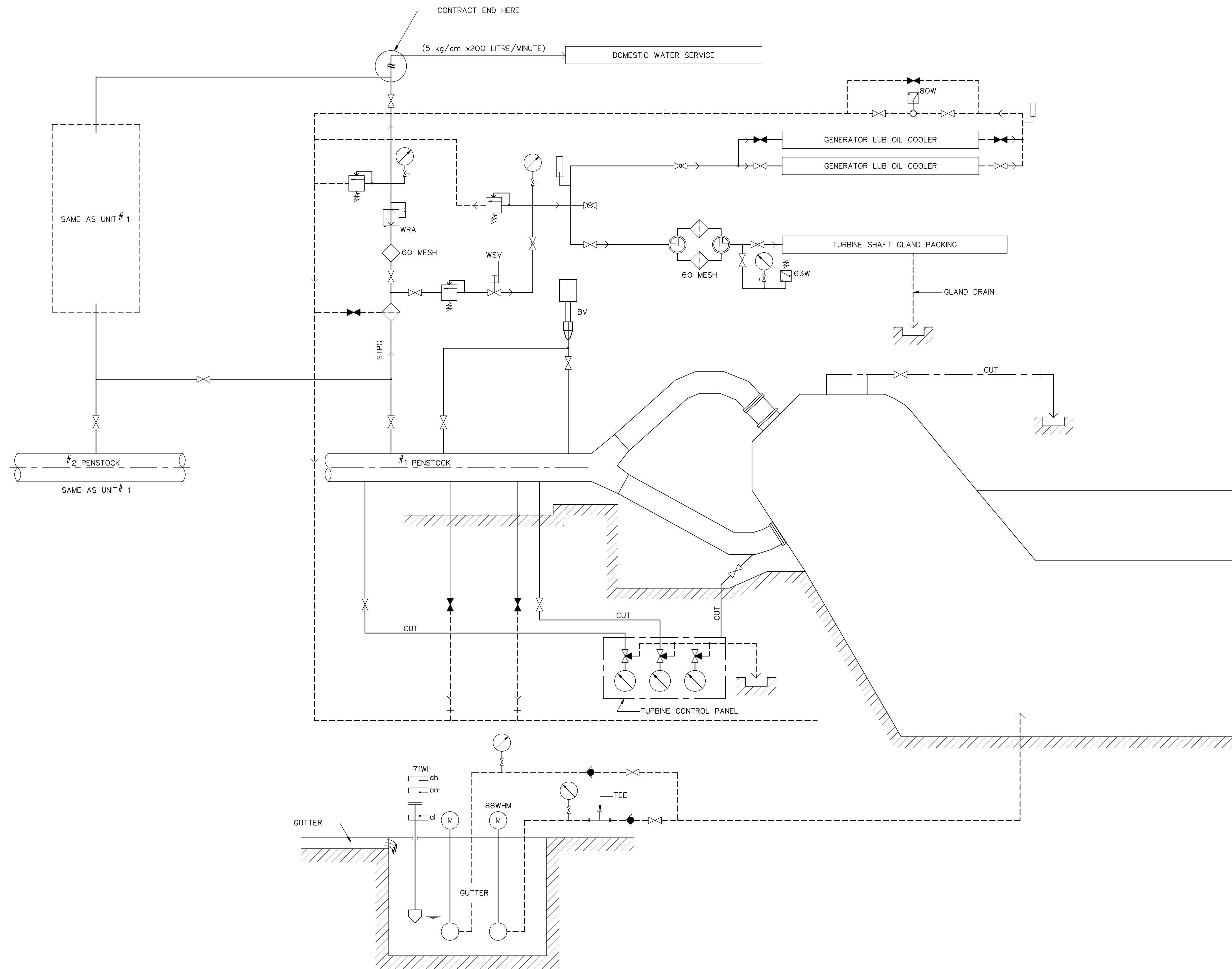


1. AC AMMETER
2. AC VOLTMETER
3. AC WATTMETER
4. WATT HOUR METER
5. UNDER VOLTAGE RELAY
6. AMMETER SELECTOR SWITCH
7. VOLTMETER SELECTOR SWITCH
8. DC AMMETER
9. DC VOLTMETER
10. DC AMMETER
11. DC UNDER VOLTAGE RELAY
12. DC GROUND FAULT RELAY
13. DC VOLTMETER SELECTOR SWITCH
14. TEST TERMINAL
15. MS1 } 3 PHASE MOTOR STARTER , TWO DIRECTIONS , FORWARD AND REVERSE
16. MS2 } WITH FORWARD AND REVERSE PUSH BUTTON , SUITABLE FOR  
3  $\phi$  , 380 V. GATE MOTORS.

1. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE SHOWN
2. THIS DRAWING IS DESIGNED FOR GUIDE LINE ONLY, IT SHALL BE DESIGNED AND SPECIFIED LATER BY CONTRACTOR C2 AND SUBMITTED TO FIELD ENGINEER FOR APPROVAL

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|     | CONSULTANTS |           | DEDE    |          |

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  <div style="text-align: center;">             KINGDOM OF THAILAND<br/>             Department of Alternative<br/>             Energy Development and Efficiency<br/> <b>MINISTRY OF ENERGY</b> </div> |  |                                                                                                                                                                                                                                                        |  |
| <h2>HUAI LAM SIN HYDROPOWER PROJECT</h2>                                                                                                                                                                                                                                                    |  |                                                                                                                                                                                                                                                        |  |
| <h3>CIVIL WORKS</h3>                                                                                                                                                                                                                                                                        |  |                                                                                                                                                                                                                                                        |  |
| <h3>MAIN CONTROL SWITCH BOARD</h3>                                                                                                                                                                                                                                                          |  |                                                                                                                                                                                                                                                        |  |
|  FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                                                                                                             |  |  <div style="text-align: center;">             Department of Alternative<br/>             Energy Development and Efficiency<br/> <b>MINISTRY OF ENERGY</b> </div> |  |
| DESIGNED                                                                                                                                                                                               |  | REVIEWED S.KITICHAJ                                                                                                                                                                                                                                    |  |
| DRAWN                                                                                                                                                                                                  |  | SUBMITTED                                                                                                                                                         |  |
| CHECKED                                                                                                                                                                                                |  | RECOMMENDED                                                                                                                                                       |  |
| PROJECT MANAGER                                                                                                                                                                                        |  | DRAWING NO. <b>HLS-EM-02</b>                                                                                                                                                                                                                           |  |
| DATE 14/01/62                                                                                                                                                                                                                                                                               |  | SHEET NO. 23 OF 25                                                                                                                                                                                                                                     |  |



LEGENDS :

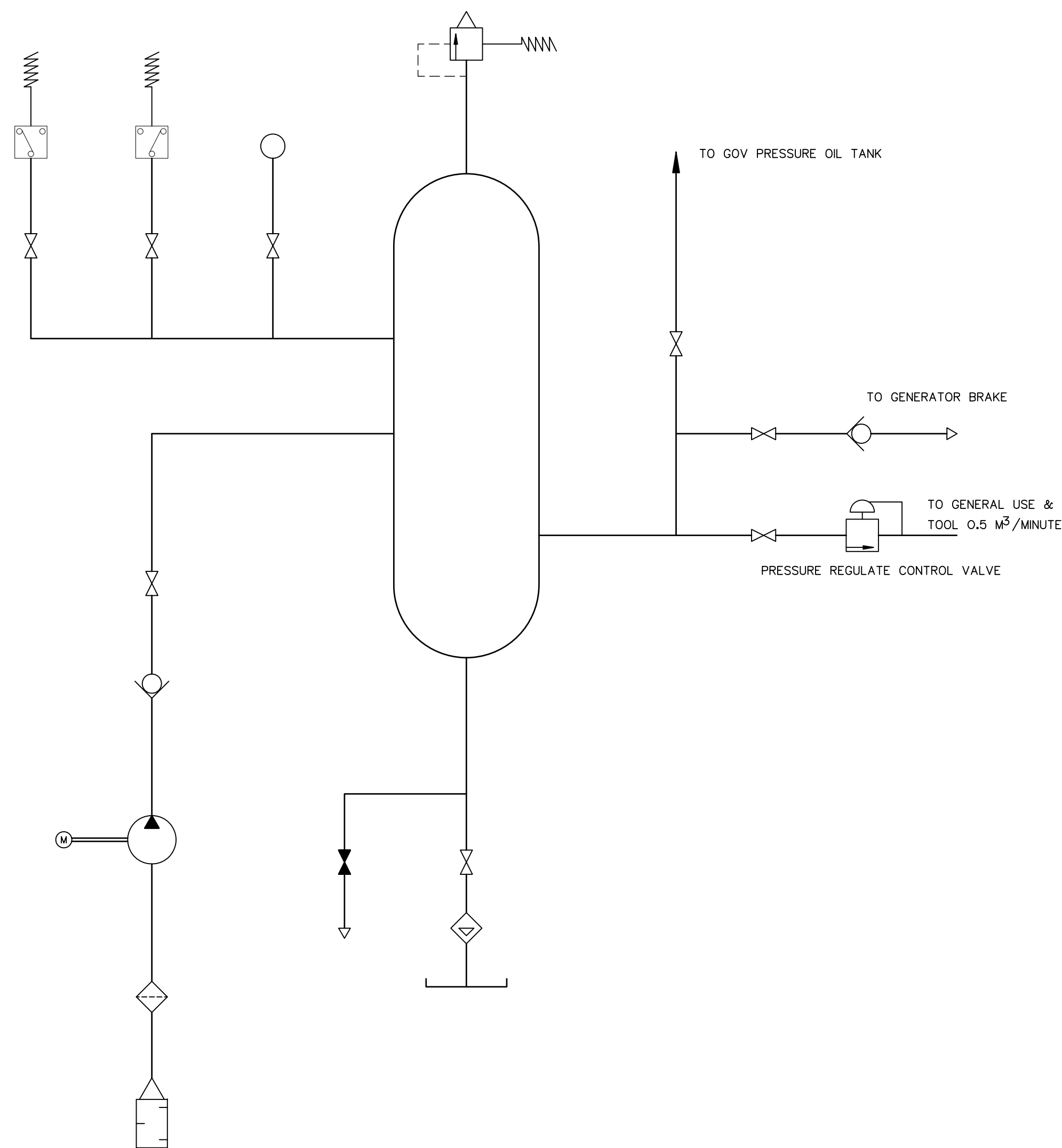
- WATER SUPPLY
- - - - - WATER DRAINAGE
- THERMOMETER
- STOP VALVE (NORMAL OPEN)
- STOP VALVE (NORMAL CLOSE)
- CHECK VALVE
- FLOW SIGTH
- THREE WAY COCK
- STRAINER
- PRESSURE GAUGE
- PRESSURE RELIEF VALVE
- △ 71WH LEVEL SWITCH FOR SUMP PIT
- 63W PRESSURE SWITCH
- 80W FLOW RELAY
- 88WHM DRAINAGE PUMP MOTOR
- WR REDUCING VALVE
- WRA AUTOMATIC REDUCING VALVE
- BV BY-PASS VALVE
- MV MAIN INLET VALVE
- SGP CARBON STEEL PIPE
- STPG CARBON STEEL PIPE
- SUSTP STAINLESS STEEL PIPE
- CUT COPPER TUBE
- WSV COOLING WATER STOP VALVE
- GLOBE VALVE

NOTE :

1. THIS DRAWING IS DESIGNED FOR GUIDE LINE ONLY, IT SHALL BE DESIGNED AND SPECIFIED LATER BY CONTRACTOR C2 AND SUBMITTED TO FIELD ENGINEER FOR APPROVAL

|     |      |             |         |          |  |                                           |                                                                                   |
|-----|------|-------------|---------|----------|--|-------------------------------------------|-----------------------------------------------------------------------------------|
| 3   |      |             |         |          |  | FRONTIER ENGINEERING CONSULTANTS CO.,LTD. | Department of Alternative Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| 2   |      |             |         |          |  | DESIGNED                                  | REVIEWED S.KTICHAJ                                                                |
| 1   |      |             |         |          |  | DRAWN                                     | SUBMITTED                                                                         |
| NO. | DATE | REVISIONS   | CHECKED | APPROVED |  | CHECKED                                   | RECOMMENDED                                                                       |
|     |      |             |         |          |  | APPROVED                                  |                                                                                   |
|     |      | CONSULTANTS |         | DEDE     |  | PROJECT MANAGER                           | DRAWING NO.<br>HLS-EM-03                                                          |
|     |      |             |         |          |  | DATE                                      | SHEET NO.<br>24 OF 25                                                             |

|                                                                                                          |
|----------------------------------------------------------------------------------------------------------|
| KINGDOM OF THAILAND<br>Department of Alternative Energy Development and Efficiency<br>MINISTRY OF ENERGY |
| HUAI LAM SIN HYDROPOWER PROJECT                                                                          |
| CIVIL WORKS                                                                                              |
| WATER SUPPLY AND DRAINAGE SCHEMATIC DIAGRAM                                                              |
| FRONTIER ENGINEERING CONSULTANTS CO.,LTD.                                                                |
| REVIEWED S.KTICHAJ                                                                                       |
| DESIGNED                                                                                                 |
| DRAWN                                                                                                    |
| CHECKED                                                                                                  |
| APPROVED                                                                                                 |
| PROJECT MANAGER                                                                                          |
| DATE                                                                                                     |
| DRAWING NO.<br>HLS-EM-03                                                                                 |
| SHEET NO.<br>24 OF 25                                                                                    |



LEGENDS :

|  |                                                                                   |  |                    |
|--|-----------------------------------------------------------------------------------|--|--------------------|
|  | AUTOMATIC CONDENSATE TRAP                                                         |  | VALVE-NON RETURN   |
|  | FILTER OR STRAINER<br>- MANUAL<br>- AUTOMATIC HAS ADDITIONAL DRAIN LINE AND VALVE |  | PRESSURE SWITCH    |
|  | VALVE-NORMALLY OPEN                                                               |  | AIR VENT           |
|  | VALVE-NORMALLY CLOSED                                                             |  | HEAD EXCHANGER     |
|  | NEEDLE VALVE                                                                      |  | FLOW RELAY         |
|  | ORIFICE                                                                           |  | FLOW METER         |
|  | VALVE-THERMOSTATICALLY CONTROLLED                                                 |  | PRESSURE GRUGE     |
|  | VALVE-PRESSURE REGULATING                                                         |  | RECEIVER           |
|  | VALVE-PRESSURE RELIEF (WATER)                                                     |  | PUMP OR COMPRESSOR |
|  | VALVE-SOLENOID OPERATED PRESSURE REDUCING                                         |  | SILENCER           |
|  | VALVE-PRESSURE RELIEF (AIR)                                                       |  | DIRECTION OF FLOW  |
|  | VALVE-SOLENOID OPERATED OIL PRESSURE ACTUATED                                     |  | MOTORIZED VALVE    |

COMPRESSED AIR SYSTEM SCHEMATIC

NOTES :

1. PIPING & FITTING TO WORK SHOP ROOM AND MACHINE HALL FOR UNIT 1 & UNIT 2 SHALL BE PROVIDED BY THE CONTRACTOR
2. THIS DRAWING IS DESIGNED FOR GUIDE LINE ONLY, IT SHALL BE DESIGNED AND SPECIFIED LATER BY CONTRACTOR C2 AND SUBMITTED TO FIELD ENGINEER FOR APPROVAL

|     |      |             |         |          |  |                                                       |                                                 |
|-----|------|-------------|---------|----------|--|-------------------------------------------------------|-------------------------------------------------|
| 3   |      |             |         |          |  | FRONTIER ENGINEERING CONSULTANTS CO.,LTD.             | REVIEWED S.KTICHAJ                              |
| 2   |      |             |         |          |  | DESIGNED <i>Sinn Witsakul</i> 28/12/197               | SUBMITTED <i>Sinn Witsakul</i>                  |
| 1   |      |             |         |          |  | DRAWN <i>Sinn Witsakul</i>                            | RECOMMENDED <i>Sinn Witsakul</i>                |
| NO. | DATE | REVISIONS   | CHECKED | APPROVED |  | CHECKED <i>Sinn Witsakul</i> 28/12/197                | APPROVED <i>Sinn Witsakul</i>                   |
|     |      | CONSULTANTS |         | DEDE     |  | <i>Sinn Witsakul</i> 14/01/62<br>PROJECT MANAGER DATE | DRAWING NO. <b>HLS-EM-04</b> SHEET NO. 25 OF 25 |