UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 6, 1990

Docket No. 50-390

LICENSEE: Tennessee Valley Authority

FACILITY: Watts Bar Nuclear Plant, Unit 1

SUBJECT: MEETING SUMMARY OF FEBRUARY 15-16, 1990 MEETING ON CABLE DAMAGE RESOLUTION PLAN

See Reports

On February 15 and 16, 1990, a meeting was held between the NRC staff and TVA's representatives at the Watts Bar site in Spring City, Tennessee. The purpose of the meeting was to discuss TVA's plans to resolve the issue of damaged electrical cable in conduits at Watts Bar, Unit 1. Enclosure 1 is the list of individuals attending the meeting. Enclosure 2 contains the meeting agenda and the handouts provided at the meeting.

The NRC staff opened the meeting by stating that a preliminary assessment of the TVA's submittal of December 20, 1989 has been completed. Based on this review, the staff has several questions/concerns regarding TVA's approach towards resolution of the issue. The meeting agenda contains the list of staff questions/concerns (this list was provided to TVA earlier). These questions/concerns provided the basis for the meeting discussions.

The majority of the discussion involved TVA's rationale for the development of the conduit screening methodology which results in the classification of conduit as high-risk, moderate-risk, or low-risk with regard to pullby susceptability.

NRC staff commented that TVA's methodology delineated by the Watts Bar Cable Damage Resolution Plan for the resolution of this problem raises many questions and implementation of this methodology alone would not alleviate the staff's concern of potential cable damage in low-risk category conduits. The proposed plan does not provide any threshold values above which the damage starts.

The NRC staff further stated that an alternate approach consisting of a test program for the low-risk category similar to that proposed for Browns Ferry would address the NRC concerns. Specifically:

1. As proposed, categorize the conduits as high-risk, moderate-risk, or low-risk.

2. Replace the cables in those conduits that are in the high or moderate risk category.

3. All low-risk category conduits will fall under the test program. "Worst case" conduits should be identified, and 20 conduits of V1/V2, and 20 conduits of V3/V4 category should be "high-potential" tested. The test program should be similar to that proposed by TVA for Browns Ferry Unit 2.

4. Evaluate the root cause of any failure from the testing and develop corrective actions.

TVA stated that they will re-evaluate their program and will inform NRC of TVA management's decision. The NRC staff concluded the meeting by stating that if the staff and TVA cannot come to a mutually acceptable test program, the staff will review in detail TVA's responses to the NRC questions.

TVA Projects Division
Office of Nuclear Reactor Regulation

Enclosure:
1. Attendance List
2. Meeting Agenda
3. Handout

cc w/enclosures:
See next page

OFC	:NRR:TVA/PM	:NRR:TVA:ROB/BC	TVA:AD/P	:	:	:
NAME	:RAuluckas	:EMarinos	:SBlack	:	:	:
DATE	:3/5/90	:3/5/90	:3/6/90	:	:	:

OFFICIAL RECORD COPY
Document Name: FEB. 15/16 MTG. SUMMARY

cc:
General Counsel
Tennessee Valley Authority
400 West Summit Hill Drive
ET 11B 33H
Knoxville, Tennessee 37902

Mr. F. L. Moreadith
Vice President, Nuclear Engineering
Tennessee Valley Authority
400 West Summit Hill Drive
WT 12A 12A
Knoxville, Tennessee 37902

Dr. Mark O. Medford
Vice President and Nuclear
Technical Director
Tennessee Valley Authority
6N 38A Lookout Place
Chattanooga, Tennessee 37402-2801

Manager, Nuclear Licensing
and Regulatory Affairs
Tennessee Valley Authority
5N 157B Lookout Place
Chattanooga, Tennessee 37402-2801

Mr. Dan Douthit, Program Manager
Watts Bar Nuclear Plant
Tennessee Valley Authority
P. O. Box 800
Spring City, Tennessee 37381

Mr. R. J. Stevens
Site Licensing Manager
Watts Bar Nuclear Plant
Tennessee Valley Authority
P. O. Box 800
Spring City, Tennessee 37381

Mr. Richard F. Wilson
Vice President, New Projects
Tennessee Valley Authority
6N 38A Lookout Place
Chattanooga, Tennessee 37402-2801

Honorable Robert Aikman
County Judge
Rhea County Courthouse
Dayton, Tennessee 37321

Honorable Johnny Powell
County Judge
Meigs County Courthouse
Route 2
Decatur, Tennessee 37322

Mr. Michael H. Mobley, Director
Division of Radiological Health
T.E.R.R.A. Building, 6th Floor
150 9th Avenue North
Nashville, Tennessee 37219-5404

Regional Administrator, Region II
U.S. Nuclear Regulatory Commission
101 Marietta Street, N.W.
Atlanta, Georgia 30323

Senior Resident Inspector
Watts Bar Nuclear Plant
U.S. Nuclear Regulatory Commission
Route 2, Box 700
Spring City, Tennessee 37381

Dr. Henry Myers, Science Advisor
Committee on Interior
and Insular Affairs
U.S. House of Representatives
Washington, D.C. 20515

Tennessee Valley Authority
Rockville Office
11921 Rockville Pike
Suite 402
Rockville, Maryland 20852

Mr. Oliver D. Kingsley, Jr.
Senior Vice President, Nuclear Power
Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

Meeting Summary, Memoranda for Trip Reports or Site Visits**

Docket File
NRC PDR
Local PDR
WBN Reading
ADSP Reading
J. Sniezek
D. Crutchfield
T. Quay
B. D. Liaw
S. Black
R. Pierson
LA
R. Auluck
P. Cortland
B. Wilson, Region II
OGC
E. Marinos
H. Garg
ACRS (10)
GPA/CA (M. Callahan) (3)
E. Jordan
B. Grimes
J. Scarborough
G. Marcus
L. Norrholm
C. Ader
J. Gray
R. Borchardt
H. Garg

*cc: Licensee/Applicant & Service List

ENCLOSURE 1

ENCLOSURE 1

ATTENDANCE ROSTER

MEETING TOPIC: WATTS BAR NUCLEAR PLANT (WBN) - ELECTRICAL CABLE DAMAGE - ASSESSMENT AND RESOLUTION PLAN

DATE: February 15, 1990

NAME	Title	Organization	Telephone
Jim Young	Nuclear Engr	WBN TVA	8761
Jim [illegible]	Chief E.E.	NE	x2441-K
W S Raughley	ENGR MGR - Nuclear	NE - WB	WB 1390
RJ Stevens	Manager - Site Licensing	WBN TVA	8650
WA Thue	Consultant		407 692-2268
ANGELO MARINOS	NRC	NRC	301-492-0768
HUKAM GARG	Elec. Engr	NRC	301-492-[illegible]
R. Auluck	Proj. Manager	NRC	301-492-0759
[illegible]	[illegible]	NRC	[illegible]
KENT W BROWN	Sr ELEC ENGR	[illegible]	[illegible]
JA KRIEG	BFN ENG [illegible]	[illegible]	[illegible]
ALLAN GENTRY	ASST SITE REP	TVA - ECP	365-3507
K.E. LEWIS	QA MEMBER	WBPT	365-3374
[illegible] Wilson	TVA - VP [illegible]	[illegible]	[illegible]
JB Gardner	Consultant [illegible]	[illegible]	[illegible]
A.K. GWAL	Elect, I&C Member	WBPT - TVA	365-3729
E.W. Whitaker	Staff Spec. - Sr VP Nuclear	TVA	751-8095
G.A. Walton	Res. Insp.	NRC	8676
PG Humphrey	Res Insp	NRC	8676
F.E. LAURENT	Asst SQM	NQA - WBN	8675
Sam W. Crowe	SQM	NQA - WBN	8667
R.L. COLLINS	ELEC. INST. SPEC.	NE/EE	x5211 - SQN

2877G

OVER →

ATTENDANCE ROSTER

MEETING TOPIC: WATTS BAR NUCLEAR PLANT (WBN) - ELECTRICAL CABLE DAMAGE - ASSESSMENT AND RESOLUTION PLAN

DATE: February 15, 1990

NAME	Title	Organization	Telephone
F L MOREADITH	VP	NUCLEAR ENGR	615-632-2021
H. Hemmati - ASCE	Const Elect Field Eng	Nuclear Const	365-3349
CHUCK McFALL	PROJECT CONTROL ENGR	PC & FS - WBN	3452 - WBN

2877G

2/15/90

Brian Reagan	Engg. Spec.	NE-EE	632-7073
R. Luther	Consultant, TVA		(203) 223-3491
T. G. HUGHES	ENG SPEC	NE-EE	365-1419
P. Reilly	SPECIAL PROJECTS PA	SWECTVA	365-3658

ATTENDANCE ROSTER

MEETING TOPIC: WATTS BAR NUCLEAR PLANT (WBN) - ELECTRICAL CABLE DAMAGE - ASSESSMENT AND RESOLUTION PLAN

DATE: February 16, 1990

NAME	Title	Organization	Telephone
Jim Young	Nucl Engr	WBN Site Lic	(615)-365-8761
Jim Watson		NE	x2442-K
M C Brickey	Lead Elect Engr	NE WBEP	x1416-
W A Thue	Consultant	to NRC	407 692-2268
Angelo Marinos	NRC	NRC	301-492-0768
[illegible]	[illegible]	[illegible]	[illegible]
R. Auluck	Project Mgr	NRC	301-492-0759
J E Farmer	Consultant to NRC	Self	[illegible]
R.L. COLLINS	ELEC. INST. SPEC.	NE/EE	615-843-5211
G.A. Walton	Res. Insp.	NRC	8676
C.P. Baker	Section Chief	[illegible]	404-[illegible]
P.G. Humphrey	Res Insp	NRC	x-8676
Chuck McFall	Project Control Engr	PC&FS - WBN	3452 - WBN
Paul Reilly	Special Projects	SWEC/TVA	655-365-3658
Tim Kries	Eng Specialist	EEB-OFC	[illegible]
TOM HUGHES	ENG SPECIALIST	NE-EE WBN	615-365-1419
R. Luther	TVA Consultant		(203)223-3491
L.E. Brock	TVA, QA Engr	NQA	8368
W. S. Raughley	ENGR MGR-NewProj	NE-WB	x2390
H. Hemmati-Arass	Const Elect Field Eng	NC	365-3349

2877G

ATTENDANCE ROSTER

MEETING TOPIC: WATTS BAR NUCLEAR PLANT (WBN) - ELECTRICAL CABLE DAMAGE - ASSESSMENT AND RESOLUTION PLAN

DATE: February 15, 1990

NAME	Title	Organization	Telephone
Jim Young	Nuclear Engr	WBN TVA	8761
Jim Watson	Chief E.E.	NE	x2441-1C
W.S. Raughley	ENGR MGR.-Newly	NE-WB	WB 1390
R.J. Stevens	Manager - Site Licensing	WBN TVA	865C
W.A. Thue	Consultant		407 692-2268
ANGELO MANNINO	NRC	NRC	301-492-0768
HUKAM SHAH	EIEC. [illegible]	NRC	301-492-4077
R. Auluck	Proj. Manager	NRC	301-492-0759
C.F. [illegible]	[illegible]	NRC	[illegible]
KENT W. [illegible]	Sr ELECTRICAL	[illegible]	615-232-[illegible]
J.A. [illegible]	[illegible]	[illegible]	[illegible]
ALLAN GENTRY	ASST SITE REP	TVA-ECP	365-3507
K.E. LEWIS	QA MEMBER	WBPT	365-3374
C.F. [illegible]	TVA [illegible]	TVA	615-[illegible]
J.B. Gardner	Consultant [illegible]	[illegible]	[illegible]
A.K. GWAL	Elect, I&C Member	WBPT-TVA	365-3729
E.W. Whitaker	Staff Spec. - Sr VP Nuclear	TVA	751-8095
G.A. Walton	Res. Insp.	NRC	8676
P.G. Humphrey	Res. Insp	NRC	8676
F.E. LAURENT	Asst SQM	NQA-WBN	8675
Sam W. Crowe	SQM	NQA-WBN	8667
R.L. COLLINS	ELEC. INST. SPEC.	NE/EE	x5211-SQN

2877G

OVER →

ATTENDANCE ROSTER

MEETING TOPIC: WATTS BAR NUCLEAR PLANT (WBN) - ELECTRICAL CABLE DAMAGE - ASSESSMENT AND RESOLUTION PLAN

DATE: February 15, 1990

NAME	Title	Organization	Telephone
F L MOREADITH	VP	NUCLEAR ENGR	615-632-2021
H. Hemmati-Asa	Const Elect Field Eng	Nuclear Const	365-3349
CHUCK McFALL	PROJECT CONTROL ENGR	PC & FS - WBN	3452 - WBN

2877G

2/15/90

Brian Reagan	Engg. Spec.	NE-EE	632-7073
R. Luther	Consultant, TUA		(203) 223-3491
T. G. HUGHES	ENG SPEC	NE-EE	365-1419
P. Reilly	SPECIAL PROJECTS PA	SWECTUA	365-3658

ENCLOSURE 2

AGENDA

Watts Bar Cable Damage Assessment

February 15, 1990

The staff and its consultants have performed the preliminary assessment of the TVA submittal dated December 20, 1989. Based on this review, the following is a preliminary list of staff questions and concerns.

1. TVA should demonstrate that SWBP calculations directly relate to potential pullby damage. Explain the process used for calculating the SBWP for the conduits which were removed from the WBN.

2. Provide and explain all key overlays of the conduit isometrics that confirm their theory of damage mechanisms.

3. How is TVA reconciling probable differences in pulling practices used in the past to assumed practices in calculations? How is the use or non-use of mid run pull points determined?

4. What are the differences in the criteria which were used to determine the worst case pullbys during the Sequoyah review to the ones used in the Browns Ferry review (new)? Explain how the 28 conduits were selected for removal from Watts Bar.

5. What is the justification for increasing SWBP values allowed in G-38? How does TVA reconcile the issues raised in the staff's TER regarding the May 1986 SWBP test report?

6. Provide the details of pull tension calculations for the conduits removed at Watts Bar to allow NRC's evaluation of assumptions and methodology used by TVA.

7. Describe actual work practices used to place pull lines used for pullbys.

8. What are the sources of non-pullby damages discussed in the UCONN report? How is this damage mechanism being addressed by TVA?

9. Describe why the concern for the jacket integrity of coax cable is not applicable to other instrumentation cables? Provide copy of CAQR 890492.

10. Describe that dry hi-pot tests are an adequate damage assessment criteria for MV cables and for LV cables.

11. PLG report Page 3-1 states that cables pulled with 2000 lb/ft or more could be damaged by pull forces alone. However, Page 1 of Enclosure 1 of the submittal says high risk cables will only be replaced if evidence of pullbys is demonstrated. What about damage based on excess SWBP?

12. Describe any electrical testing done on cables prior to their removal.

13. Provide copies of the references listed on Page 11 of their December 20, 1989 submittal.

14. Explain all basic assumptions used in the PLG Backup study, e.g., damage with pull rope will occur at much lower SWBP compared to pull wire, coefficient of friction will be higher than 0.75 in case of pull rope compared to pull wire, etc.

WBN CABLE PULLBYS
NRC QUESTION #1

* QUESTION;
  A) "TVA SHOULD DEMONSTRATE THAT SWBP CALCULATIONS DIRECTLY RELATE TO POTENTIAL PULLBY DAMAGE."

* ANSWER;
  A) OVERLAYS OF THE CABLE DAMAGE ON THE CONDUIT ISOMETRICS DEMONSTRATED A DIRECT CORRELATION BETWEEN SWBP AND DAMAGE FOR ALL OF THE UNIT 2 PULLBY DAMAGE LOCATIONS. SWBP ALSO IS A MEASURE OF THE CABLE-TO-CABLE FORCES AND AN INDICATOR OF THE DIFFICULTY OF A PULL AND THE LIKELIHOOD FOR A PULL ROPE TO SPIRAL WITH ITS CABLES.

* QUESTION;
  B) "EXPLAIN THE PROCESS USED FOR CALCULATING THE SWBP FOR THE CONDUITS WHICH WERE REMOVED FROM THE WBN."

* ANSWER;
  B) SWBP CALCULATIONS WERE PERFORMED ON THE CABLES REMOVED FROM WBN FOR SCOPE ASSESSMENT USING THE METHODOLOGY DEFINED IN G-38. THESE EQUATIONS FOLLOW INDUSTRY STANDARD PRACTICES AND ARE ENCODED IN THE TVA QA PROGRAM 'CBLPUL'. CONDUITS WERE FIRST WALKED DOWN TO DETERMINE LENGTHS AND ANGLES. THEN RECORDS WERE REVIEWED TO DETERMINE PULL GROUPINGS. THIS DATA WAS THEN INPUT TO THE PROGRAM.

WBN CABLE PULLBYS
NRC QUESTION #2

QUESTION:

- "PROVIDE AND EXPLAIN ALL KEY OVERLAYS OF THE CONDUIT ISOMETRICS THAT CONFIRM THEIR THEORY OF DAMAGE MECHANISMS."

ANSWER:

- KEY OVERLAYS OF THE CONDUIT ISOMETRICS ARE BEING PROVIDED.
- SIDEWALL BEARING PRESSURE AND PULL TENSION CALCULATIONS INDICATE VALUES IN EXCESS OF G-38 LIMITS IN THE SECTIONS OF THE U-2 CONDUITS WHERE THE MOST SEVERE DAMAGE OCCURED.
- THE MOST SEVERELY DAMAGED CABLES (CONDUCTOR EXPOSED) WERE INSTALLED IN THE CONDUITS PRIOR TO THE PULLBY WITH HIGHEST SIDEWALL BEARING PRESSURE.

WBN CABLE PULLBYS
NRC QUESTION #3

* QUESTION;
  A) HOW IS TVA RECONCILING PROBABLE DIFFERENCES IN PULLING PRACTICES USED IN THE PAST TO ASSUMED PRACTICES IN CALCULATIONS?

* ANSWER;
  A) THE CALCULATIONS FOR THE REMOVED CABLES ARE BASED ON WALKDOWN DATA AND PULL CARD DATA. IT IS ASSUMED THAT PULLBYS WERE PRACTICED RATHER THAN PULLBACK AND REPULL.

* QUESTION;
  B) HOW IS THE USE OR NON-USE OF MID RUN PULL POINTS DETERMINED?

* ANSWER;
  B) IN THE RIGOROUS CALCULATIONS PERFORMED BY TVA ON THE CABLES REMOVED, EACH PULL POINT IS ASSUMED TO HAVE BEEN USED. NO DATA TO THE CONTRARY EXISTS. EVIDENCE FROM THE CABLE REMOVAL INDICATES THAT ALL PULL POINTS WERE USED. NONE OF THE OBSERVED PULLBY DAMAGE WAS LOCATED AT A PULL POINT. GIVEN THE SMALL RADIUS OF CONDULETS DAMAGE WOULD HAVE OCCURRED IF THESE WERE BY-PASSED GIVEN THE SEVERITY OF THE PULLBYS.

WBN CABLE PULLBYS

NRC QUESTION #4

- QUESTION;
  A) WHAT ARE THE DIFFERENCES IN THE CRITERIA WHICH WERE USED TO DETERMINE THE WORST CASE PULLBYS DURING THE SQN REVIEW TO THE ONES USED IN THE BFN REVIEW (NEW)?

- ANSWER;
  A) NOT APPLICABLE TO WBN

- QUESTION;
  B) EXPLAIN HOW THE 28 CONDUITS WERE SELECTED FOR REMOVAL FROM WATTS BAR.

- ANSWER;
  B) * 14 CONDUITS WERE CHOSEN FROM UNIT 1 WHICH WERE EQUIVALENT TO THE UNIT 2 RUN IN WHICH THE DAMAGE WAS IDENTIFIED
  * 4 CONDUITS WERE SELECTED FROM THE WBN WORST CASE PULLBY CALCULATION
  * 10 CONDUITS WERE CHOSEN BASED ON A REVIEW OF THE CCRS FOR LENGTH AND FILL AND A CONFIRMATION OF PULLBY ACTIVITY

- V2 >25 FEET AND >50% ALLOWABLE FILL
  V3 >25 FEET AND >100% ALLOWABLE FILL
  V4 MINIMUM 4 CABLES >25 FEET AND >50% ALLOWABLE FILL

WBN CABLE PULLBYS

NRC QUESTION #5

QUESTION:

- "WHAT IS THE JUSTIFICATION FOR INCREASING SWBP VALUES ALLOWED IN G-38? HOW DOES TVA RECONCILE THE ISSUES RAISED IN THE STAFFS TER REGARDING THE MAY 1986 SWBP TEST REPORT?"

ANSWER:

- THE ORIGINAL VALUES WERE BASED ON STANDARDS AND INFORMATION SUPPLIED BY CABLE VENDORS.
- NEW VALUES ARE BASED ON TVA AND EPRI TEST RESULTS.
- THE TEST OBJECTIVE WAS TO IDENTIFY PERMISSIBLE SWBPs.

WBN CABLE PULLBYS
NRC QUESTION #6

QUESTION:

- "PROVIDE THE DETAILS OF PULL TENSION CALCULATIONS FOR THE CONDUITS REMOVED AT WATTS BAR TO ALLOW NRC's EVALUATION OF ASSUMPTIONS AND METHODOLOGY USED BY TVA."

ANSWER:

- WALKDOWNS WERE PERFORMED TO DETERMINE CONDUIT CONFIGURATION (I.E. LENGTH AND DEGREES OF BENDS).
- INSTALLATION RECORDS WERE REVIEWED TO DETERMINE CABLE GROUPINGS AND PULL DATES.
- A BASIC COEFFICIENT OF FRICTION OF 0.3 ON INITIAL PULLS AND 0.75 ON PULLBYS WAS USED.
- PULL TENSIONS WERE CALCULATED USING THE FOLLOWING *BASIC* EQUATION;

  $$T = L * W * K * EXP(K*A)$$

  WHERE:

  L=CONDUIT SEGMENT LENGTH — K=COEFFICIENT OF FRICTION

  W=WEIGHT OF CABLES IN PULLBY — A=ANGLE IN RADIANS

- SWBP WAS CALCULATED USING THE FOLLOWING *BASIC* EQUATION:

  $$SWBP = T / R$$

  WHERE:

  T = CALCULATED PULL TENSION, POUNDS

  R = RADIUS OF BEND, FEET

WBN CABLE PULLBYS

NRC QUESTION #7

QUESTION:

- "DESCRIBE ACTUAL WORK PRACTICES USED TO PLACE PULL LINES USED FOR PULLBYS."

ANSWER:

- OLD PRACTICE
  - PULL ROPES OR PULL WIRES WERE SOMETIMES INSTALLED WITH THE CABLES DURING THE CABLE PULL.
  - THOSE PULL ROPES OR PULL WIRES WERE THEN USED TO PERFORM A CABLE PULLBY.
- NEW PRACTICE
  - EXISTING PULL ROPES OR WIRES ARE NOT USED SINCE APRIL 10, 1989.
  - NO PULL ROPES OR WIRES ARE INSTALLED WITH NEW CABLE PULLS.

WBN CABLE PULLBYS
NRC QUESTION #8

- QUESTION;
  A) WHAT ARE THE SOURCES OF NON-PULLBY DAMAGES DISCUSSED IN THE UCONN REPORT?

- ANSWER;
  A) VARIOUS NICKS AND SCRAPES TO JACKETS WERE NOTED WHICH ARE CONSIDERED TO BE TYPICAL OF THE RIGORS OF INSTALLATION.

- QUESTION;
  B) HOW IS THIS MECHANISM BEING ADDRESSED BY TVA?

- ANSWER;
  B) * ALL COAXIAL CABLES REQUIRED FOR 10CFR50.49 OR REG GUIDE 1.97 SERVICE ARE BEING REPLACED WITH CABLES OF DOUBLE JACKET CONSTRUCTION
  * SUCH DAMAGE IS NON-SIGNIFICANT TO OTHER CABLE TYPES AND THEREFORE NO ACTION IS PLANNED

WBN CABLE PULLBYS
NRC QUESTION #9

- QUESTION;
  "DESCRIBE WHY THE CONCERN FOR THE JACKET INTEGRITY OF COAX CABLE IS NOT APPLICABLE TO OTHER INSTRUMENTATION CABLES?"

- ANSWER;
  THE CONCERN FOR COAX IS FOR MOISTURE GETTING UNDER THE JACKET AND BEING 'WICKED UP' BY THE BRAID TO THE CONNECTORS. BULK MOISTURE AT THE CONNECTORS MAY UNACCEPTABLY DEGRADE SIGNALS. OTHER INSTRUMENTATION CABLES ARE TWISTED SHIELDED PAIRS (NOT COAXIAL) AND DO NOT HAVE THE BRAIDED SHIELD. WHERE THE END DEVICE IS MOISTURE SENSITIVE CONDUIT SEALS ARE PROVIDED.

WBN CABLE PULLBYS

NRC QUESTION #10

- QUESTION;
- "DESCRIBE THAT DRY HI-POT TESTS ARE AN ADEQUATE DAMAGE ASSESSMENT FOR MV CABLES AND LV CABLES"

- ANSWER;
- DRY HI-POT TESTS ARE STANDARD FOR SHIELDED MV CABLES (REFERENCE IEEE 400 AND ICEA TESTS)
- NO HI-POT TESTING IS PROPOSED FOR LV CABLES AT WBN

WBN CABLE PULLBYS
NRC QUESTION #11

- QUESTION;
  PLG REPORT PAGE 3-1 STATES THAT CABLES PULLED WITH 2000 LB/FT OR MORE COULD BE DAMAGED BY PULL FORCES ALONE. HOWEVER, PAGE 1 OF ENCLOSURE 1 OF THE SUBMITTAL SAYS HIGH RISK CABLES WILL ONLY BE REPLACED IF EVIDENCE OF PULLBYS IS DEMONSTRATED. WHAT ABOUT DAMAGE BASED ON EXCESS SWBP?

- ANSWER;
  SCREENING CALCULATIONS USED TO CATEGORIZE CONDUITS WERE BASED ON THE ASSUMPTION THAT PULLBYS HAD OCCURRED IN EVERY CONDUIT. ASSUMED PULLBYS WERE LARGE AND COEFFICIENT OF FRICTIONS WERE 0.75, 0.85 OR 1.0 DEPENDENT ON CONDUIT FILL. IF NO PULLBY ACTUALLY OCCURRED THE C.O.F. WOULD HAVE BEEN SIGNIFICANTLY LOWER AND THE SWBP WOULD HAVE BEEN CORRESPONDINGLY LOWER.

WBN CABLE PULLBYS
NRC QUESTION #12

QUESTION:

- "DESCRIBE ANY ELECTRICAL TESTING DONE ON CABLES PRIOR TO THEIR REMOVAL."

ANSWER:

- IMMEDIATELY PRIOR TO THEIR REMOVAL, NO TESTING WAS PERFORMED.

WBN CABLE PULLBYS
NRC QUESTION #13

QUESTION:

- "PROVIDE COPIES OF THE REFERENCES LISTED ON PAGE 11 OF THEIR DECEMBER 20, 1989 SUBMITTAL."

ANSWER:

- COPIES OF REFERENCES ARE BEING PROVIDED.

WBN CABLE PULLBYS
NRC QUESTION #14

* QUESTION;
  EXPLAIN ALL BASIC ASSUMPTIONS USED IN THE PLG BACKUP STUDY, e.g., DAMAGE WITH PULL ROPE WILL OCCUR AT MUCH LOWER SWBP COMPARED TO PULL WIRE, COEFFICIENT OF FRICTION WILL BE HIGHER THAN 0.75 IN THE CASE OF PULL ROPE COMPARED TO PULL WIRE, etc.

* ANSWER;
  PULLCHARTS USED IN THE PLG STUDY WERE DEVELOPED AS FOLLOWS;

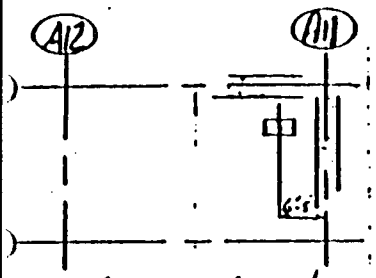
  . SEPARATE CHARTS WERE DEVELOPED FOR V1/V2, V3 AND V4
  . SEPARATE CHARTS WERE DEVELOPED FOR SIX FILL CATEGORIES

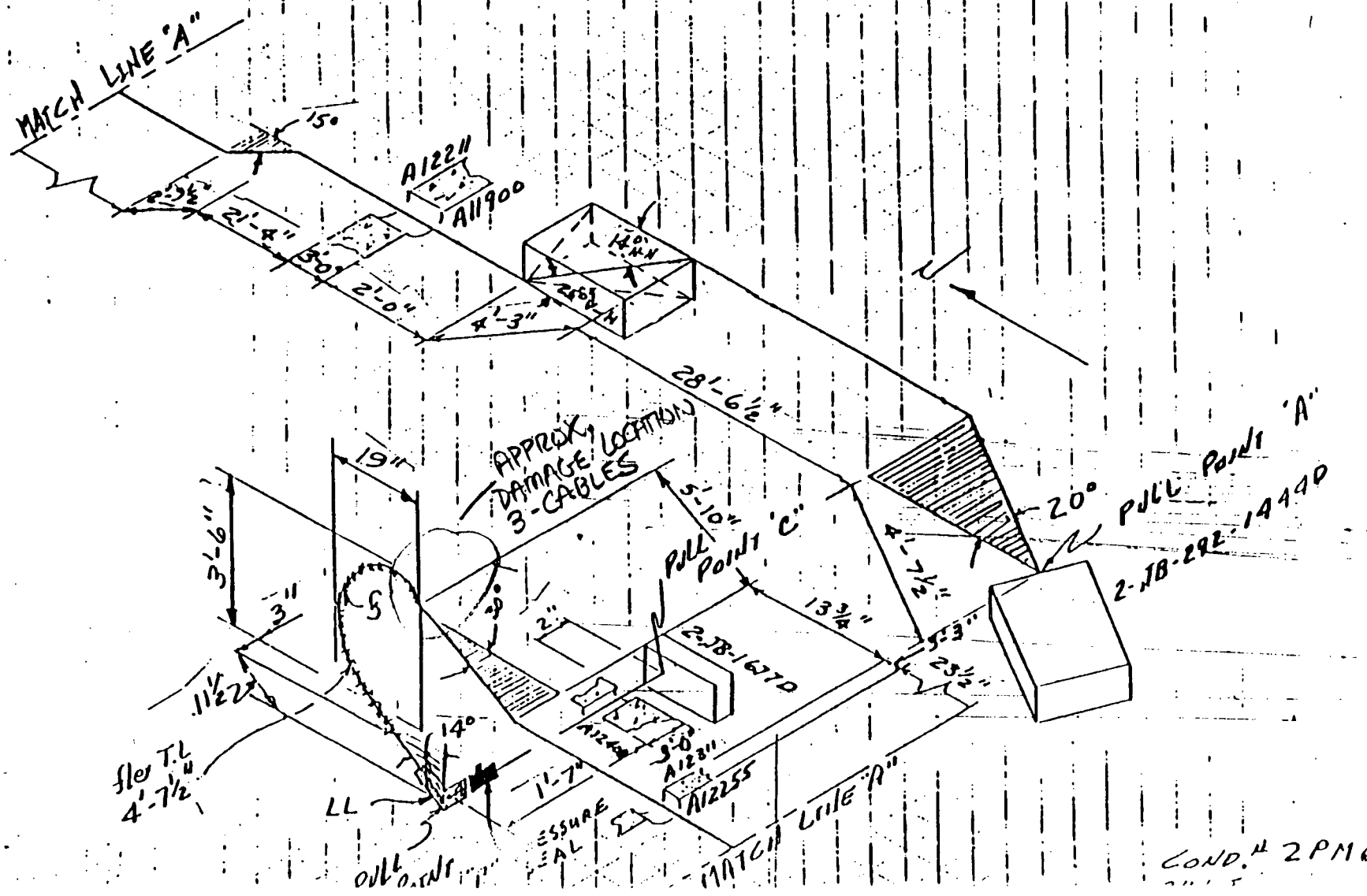
  THE FOLLOWING ASSUMPTIONS WERE APPLIED;

  . PULLBYS OCCURED IN EVERY CONDUIT
  . PULLBYS WERE LARGE
  . MORE THAN 360 DEGREES EXISTED BETWEEN PULL POINTS
  . NO INTERMEDIATE PULL POINTS EXISTED
  . CONDUIT WAS THE MAXIMUM LENGTH IN ITS RANGE
  . FOR THE 10–40% FILL CATEGORIES 0.75 C.O.F. WAS USED
    IN THE 50% FILL CATEGORY A 0.85 C.O.F. WAS USED
    IN THE 60% FILL CATEGORY A 1.0 C.O.F. WAS USED

Prepared by R.S. Davis Date 8-7-89
Checked by Philip A. Elia Date 8-7-89

QIK LEE WBN 8904
Attachment 5
Page 2





QIR LEE WBN 89004
Attachment 5
Page 80

COMPUTED WTT DATE 8-8-
CHECKED RSD DATE 8/23/

CALCULATION OF PULL TENSIONS AND SIDE WALL PRESSURES

WATTS BAR CALCULATION PACKAGE NUMBER 2PM6470D-9A
PAGE 2

FORWARD PULL ← FROM JB 1444 TO LL AT PULL POINT

SEG NUM	SEGMENT TYPE	LENGTH IN FT	ANGLE FROM HORIZ	BEND ANGLE	PULLING TENSION IN LBS	SIDEWALL PRESSURE IN LBS
1	HORIZONTAL	4.63	0.00	0.00	3.03	
2	H BEND	0.00	0.00	20.00	4.37	3.22
3	HORIZONTAL	28.54	0.00	0.00	23.04	
4	BEND, H-V DN	0.00	0.00	14.00	29.93	22.05
5	INCLINED DN	4.25	25.00	0.00	31.33	
6	BEND, V DN-H	0.00	0.00	14.00	40.30	29.70
7	HORIZONTAL	26.33	0.00	0.00	57.53	
8	H BEND	0.00	0.00	15.00	75.73	55.80
9	HORIZONTAL	2.79	0.00	0.00	77.55	
10	H BEND	0.00	0.00	15.00	102.09	75.22
11	HORIZONTAL	6.35	0.00	0.00	106.24	
12	H BEND	0.00	0.00	30.00	184.10	135.65
13	HORIZONTAL	7.42	0.00	0.00	188.95	
14	BEND, H-V DN	0.00	0.00	90.00	983.97	725.03
15	INCLINED DN	1.00	90.00	0.00	983.35	
16	BEND, V DN-H	0.00	0.00	14.00	1270.77	936.36
17	INCLINED DN	1.71	76.00	0.00	1270.01	
18	BEND, H-V DN	0.00	0.00	14.00	1641.61	1209.61
19	INCLINED DN	1.29	90.00	0.00	1640.81	

TOTAL OF BEND ANGLES IN PULL: 226.00 DEGREES ← OF THIS SUB-SEGMENT ONLY

MAXIMUM EXPECTED PULLING TENSION (Texp): 1641.61 LBS/FT
MAXIMUM EXPECTED SIDEWALL PRESSURE (SWPexp): 1209.61 LBS/FT
MAXIMUM EXPECTED TENSION FOR FIGURING SIDEWALL PRESSURE: 1641.61 LBS

APPROXIMATE DAMAGE LOCATION

QIR LEE WBN 89004
Attachment 5
Page 81

COMPUTED WJY DATE 5-8-9
CHECKED RSD DATE 8/21

CALCULATION OF PULL TENSIONS AND SIDE WALL PRESSURES

WATTS BAR CALCULATION PACKAGE NUMBER 2PM6470D-PA
PAGE 3

REVERSE PULL

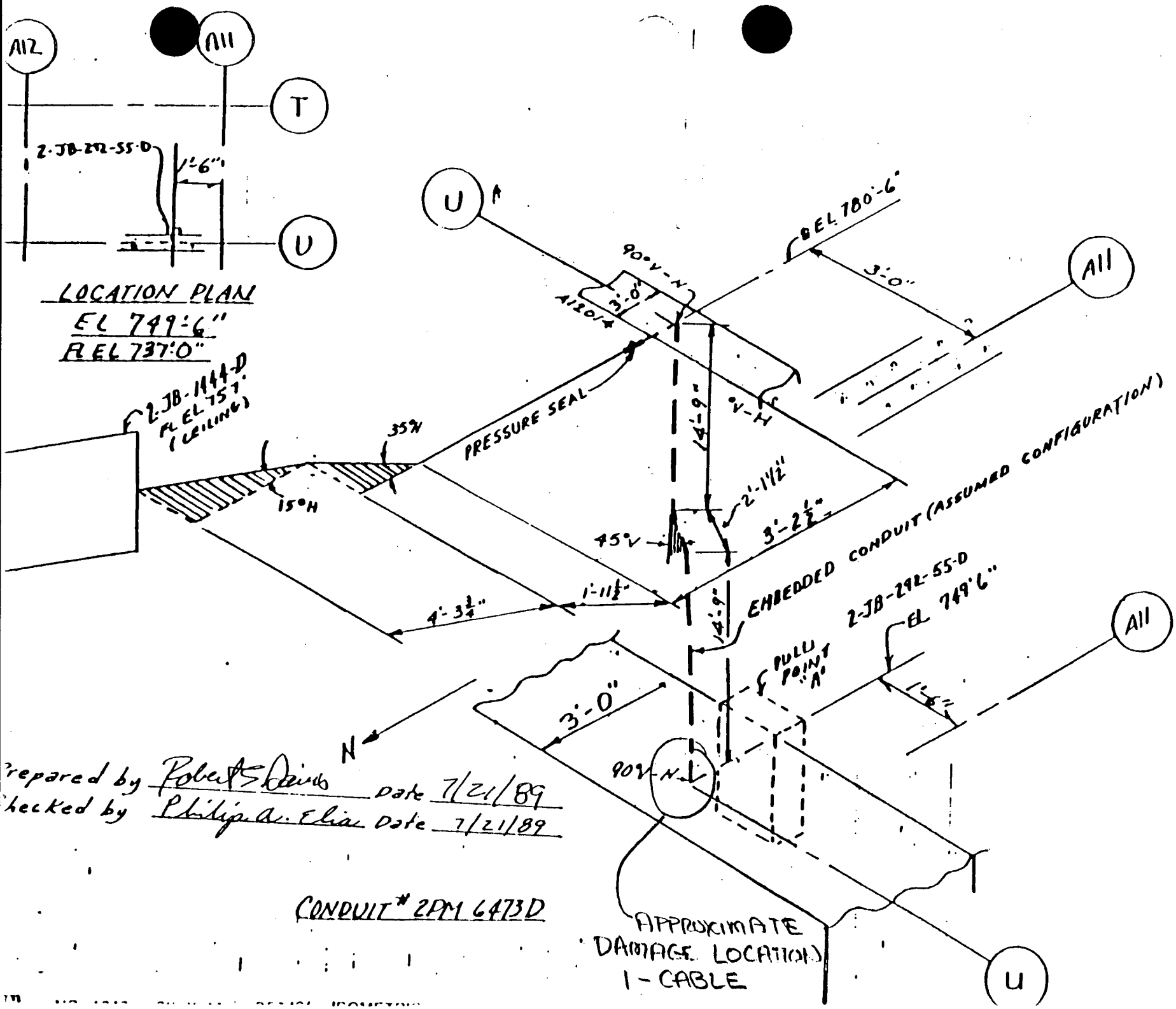
FROM LL AT PULL POINT 'B' TO BOX 1444

SEG NUM	TENSION IN LBS	PRESSURE IN LBS
19	0.80	
18	1.23	0.91
17	2.54	
16	3.12	2.30
15	3.75	
14	22.55	16.61 ← APPROXIMATE DAMAGE LOCATION
13	27.40	
12	47.48	34.99
11	51.64	
10	67.97	50.08
9	69.80	
8	91.88	67.70
	109.10	
	140.86	103.79
	144.50	
4	186.96	137.76
3	205.63	
2	296.66	218.59
1	299.69	

MAXIMUM PULLING TENSION ON REVERSE PULL (Texp): 299.69 LBS/FT
(TENSION OF 1641.61 LBS FOR FORWARD PULL)

MAXIMUM SIDEWALL PRESSURE ON REVERSE PULL (SWPexp): 218.59 LBS/FT
(SIDEWALL PRESSURE OF 1209.61 LBS FOR FORWARD PULL)
MAXIMUM TENSION FOR SIDEWALL PRESSURE ON REVERSE PULL: 296.66 LBS

Attachment 6
Page 1 of 57



Prepared by Robert S Davis Date 7/21/89
Checked by Philip A. Elias Date 7/21/89

CONDUIT # 2PM 6473D

David Stevens 1 7-20-89
FIRST PARTY VERIFICATION / DATE
Michael W Burton 1 7-20-89
SECOND PARTY VERIFICATION / DATE

Attachment H
LOP
DESCRIPTION OF WORK

Workplan No. FA00022 Rev.No. 1

Page ___ of ___

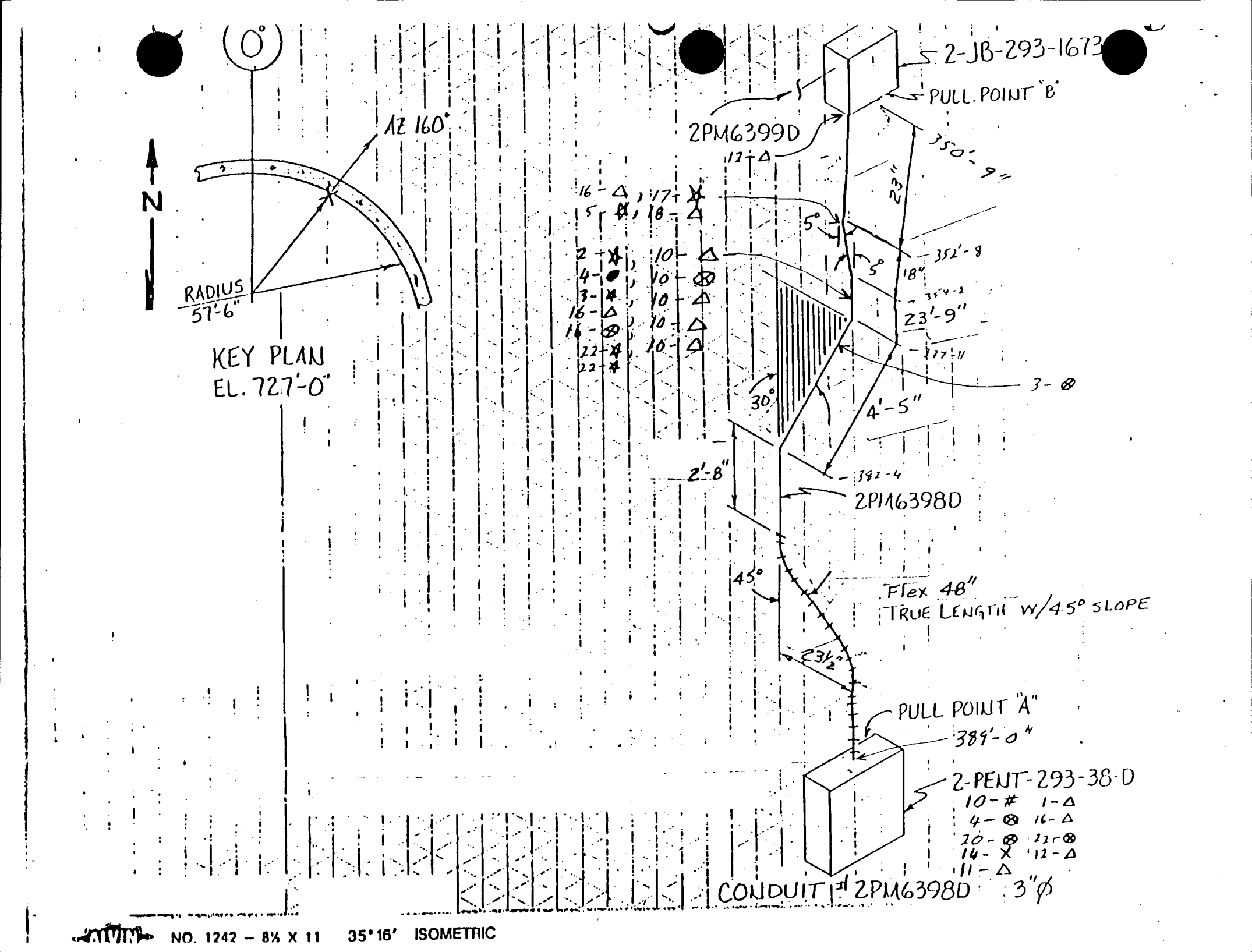
#19

STEP NO.	HOLD POINT	DESCRIPTION		
21. (CONT.)		SEQUOYAH #	DISTANCE FROM 2-JB-292-1696-0	TYPE DAMAGE
■	6474	2PM 791 D-H 2PM 791D-1	30'-9"	TORN JACKET
●	6424	2PM 791D-2	270'-9"	PINCH IN JACKET

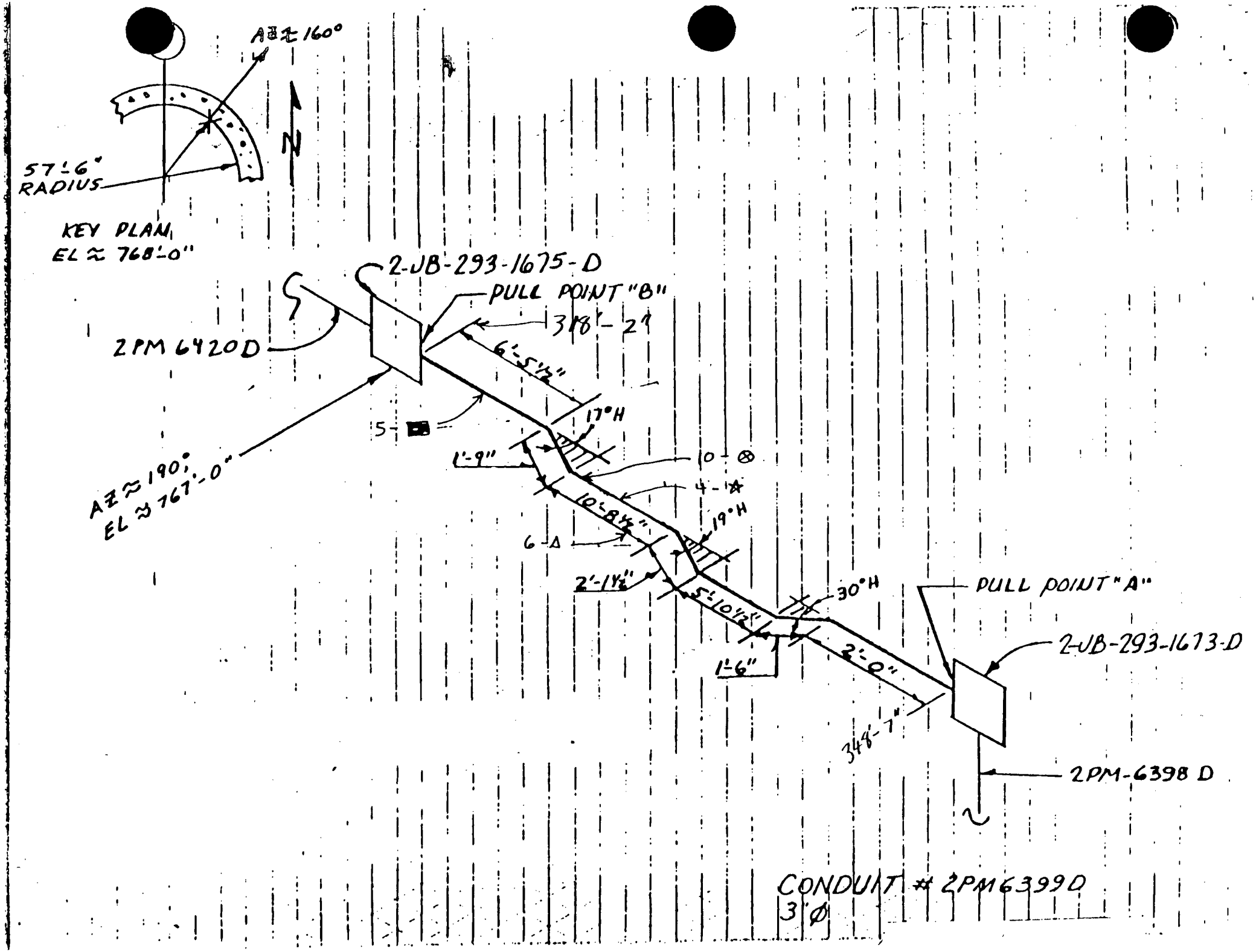
Material verification required prior to fitup. ☐ YES ☐ NO

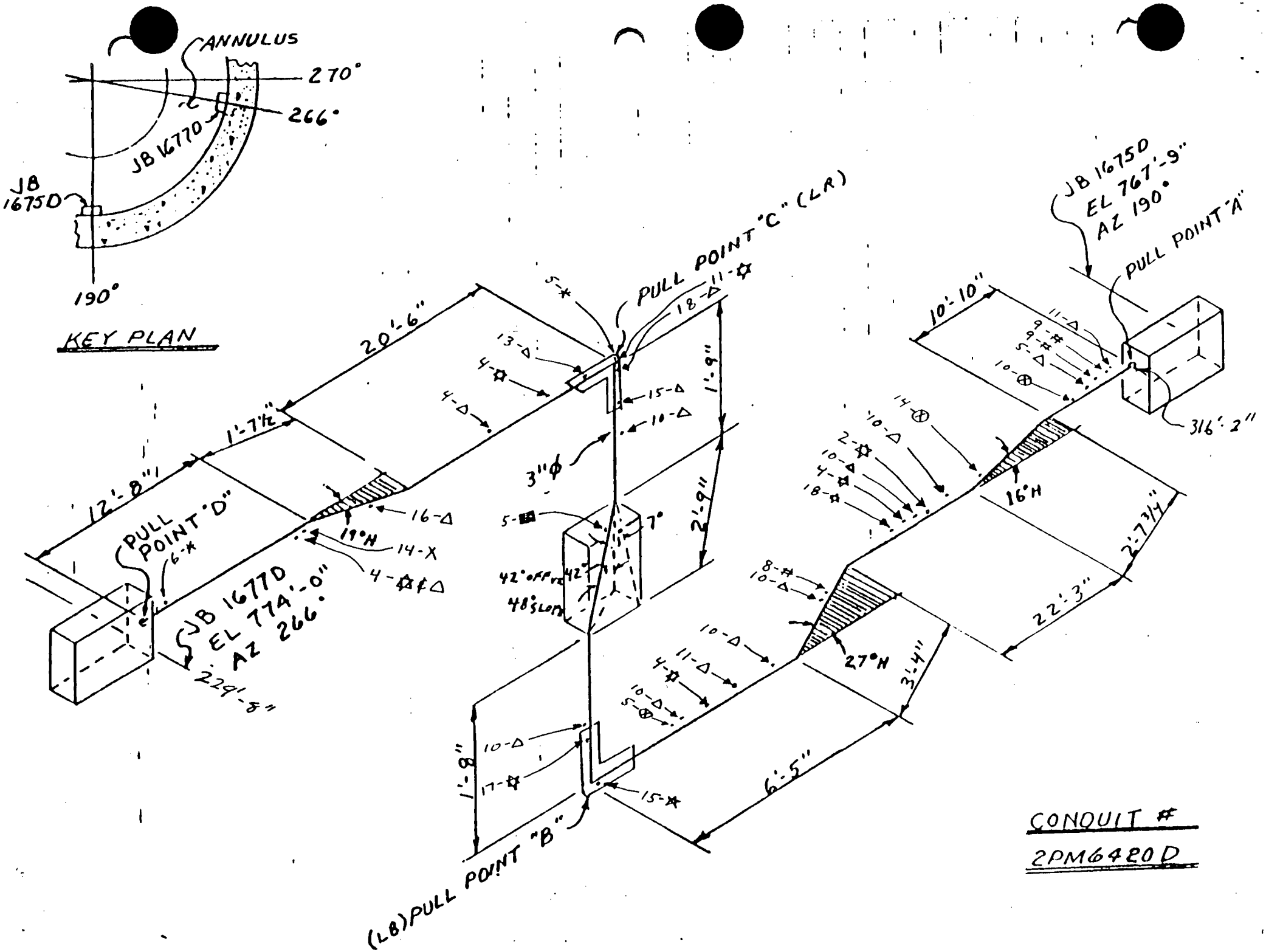
WBN CABLE PULLBYS
KEY OVERLAYS

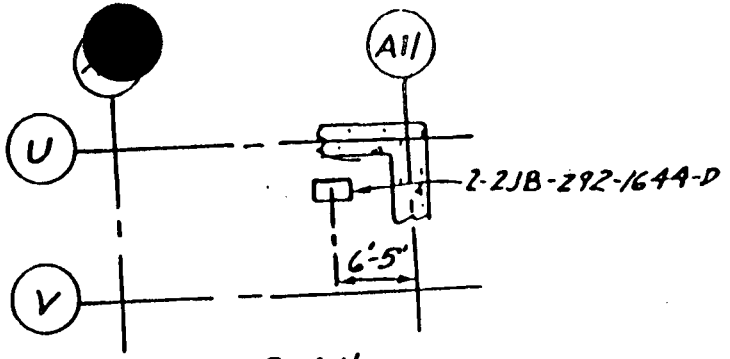
OVERLAYS WITH ALL DAMAGE TYPES



NO. 1242 – 8½ X 11 35°16' ISOMETRIC

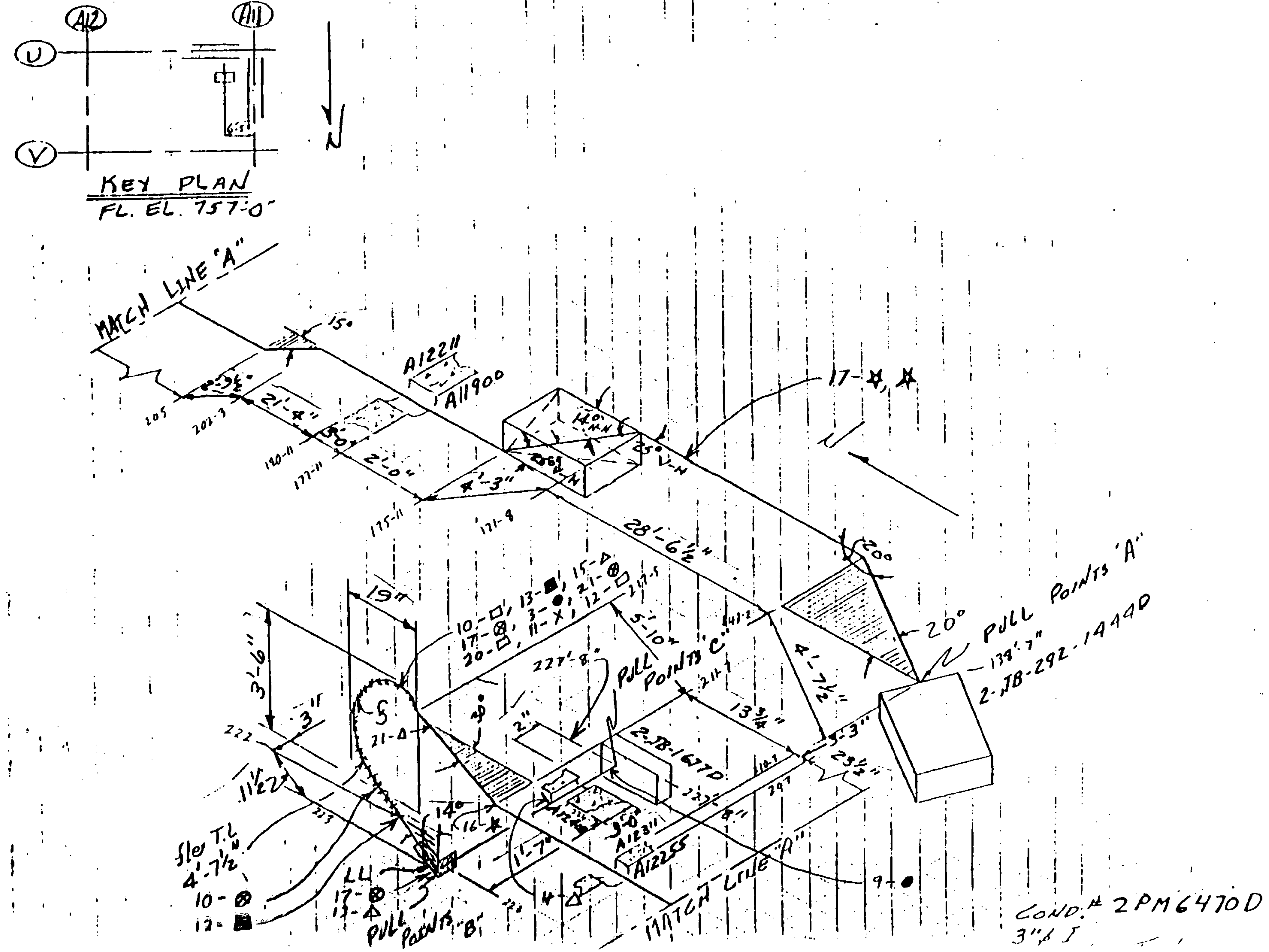

AZ ≈ 160°
57'-6" RADIUS
N
KEY PLAN
EL ≈ 768'-0"
2-UB-293-1675-D
PULL POINT "B"
318'-2"
2PM 6420D
6'-5½"
17°H
5-
AZ ≈ 190°
EL ≈ 767'-0"
1'-9"
10-⊗
4-☆
10'-8½"
19°H
6-△
2'-1½"
5'-10½"
30°H
PULL POINT "A"
2-UB-293-1673-D
1'-6"
2'-0"
348'-1"
2PM-6398 D
CONDUIT # 2PM63990
3'Ø


ANNULUS
270°
266°
JB 16770
JB 16750
190°
KEY PLAN
PULL POINT "C" (LR)
PULL POINT "A"
JB 16750
EL 767'-9"
AZ 190°
PULL POINT "D"
JB 16770
EL 774'-0"
AZ 266°
(LB) PULL POINT "B"
CONDUIT #
2PM6420D

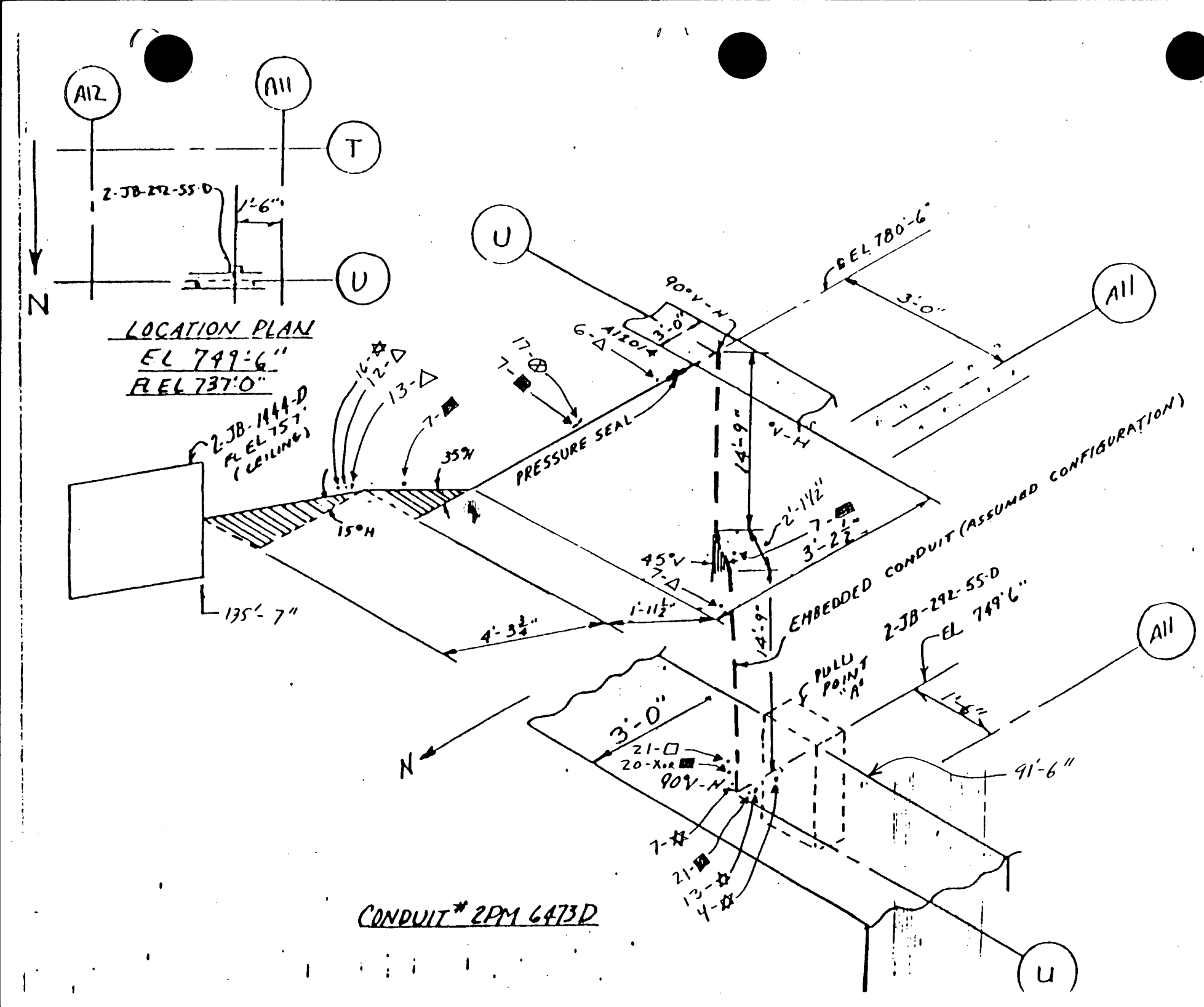


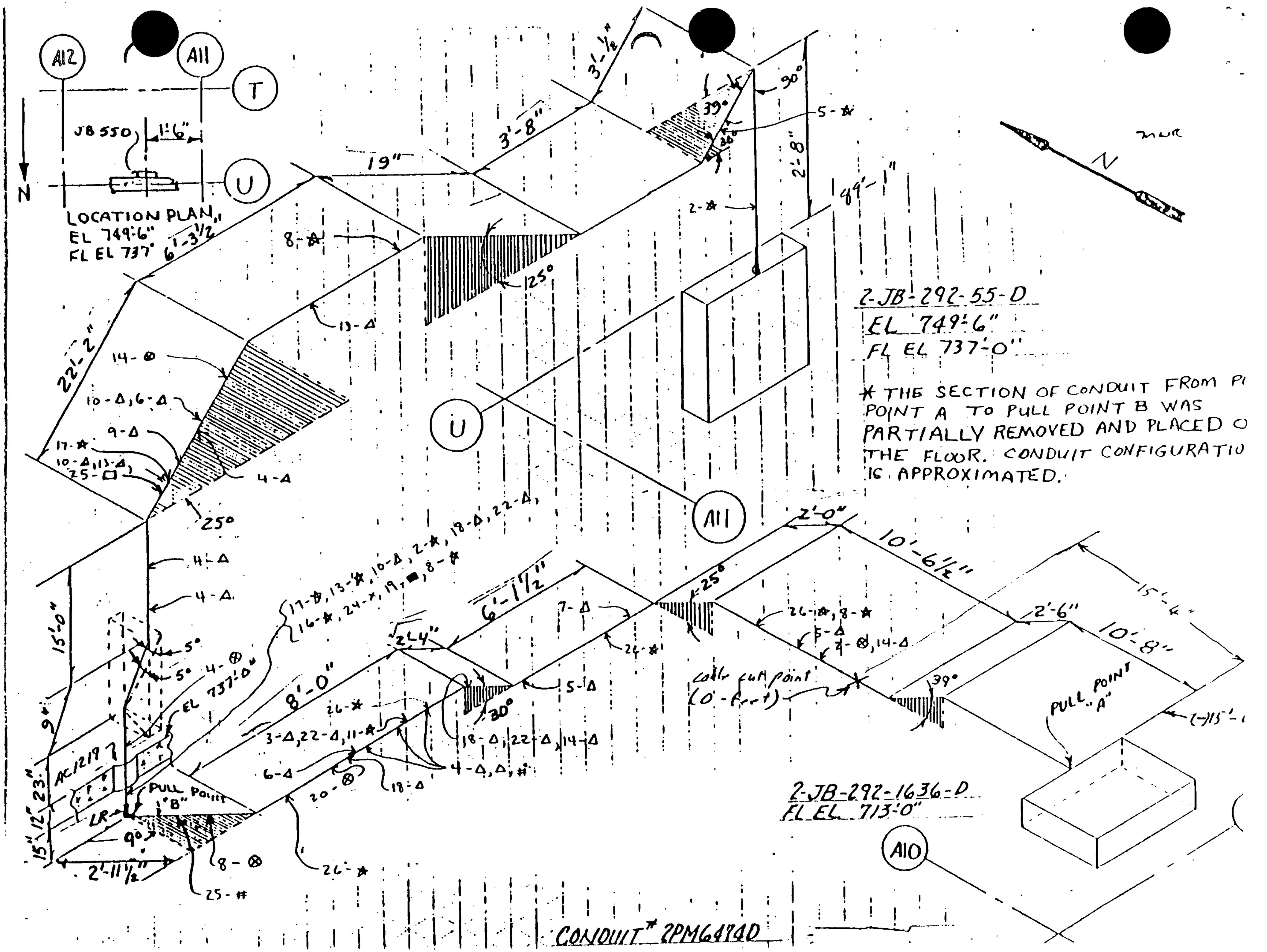
KEY PLAN
FL EL 757'-0"

CONDUIT 2PM6451D
SIZE 1"

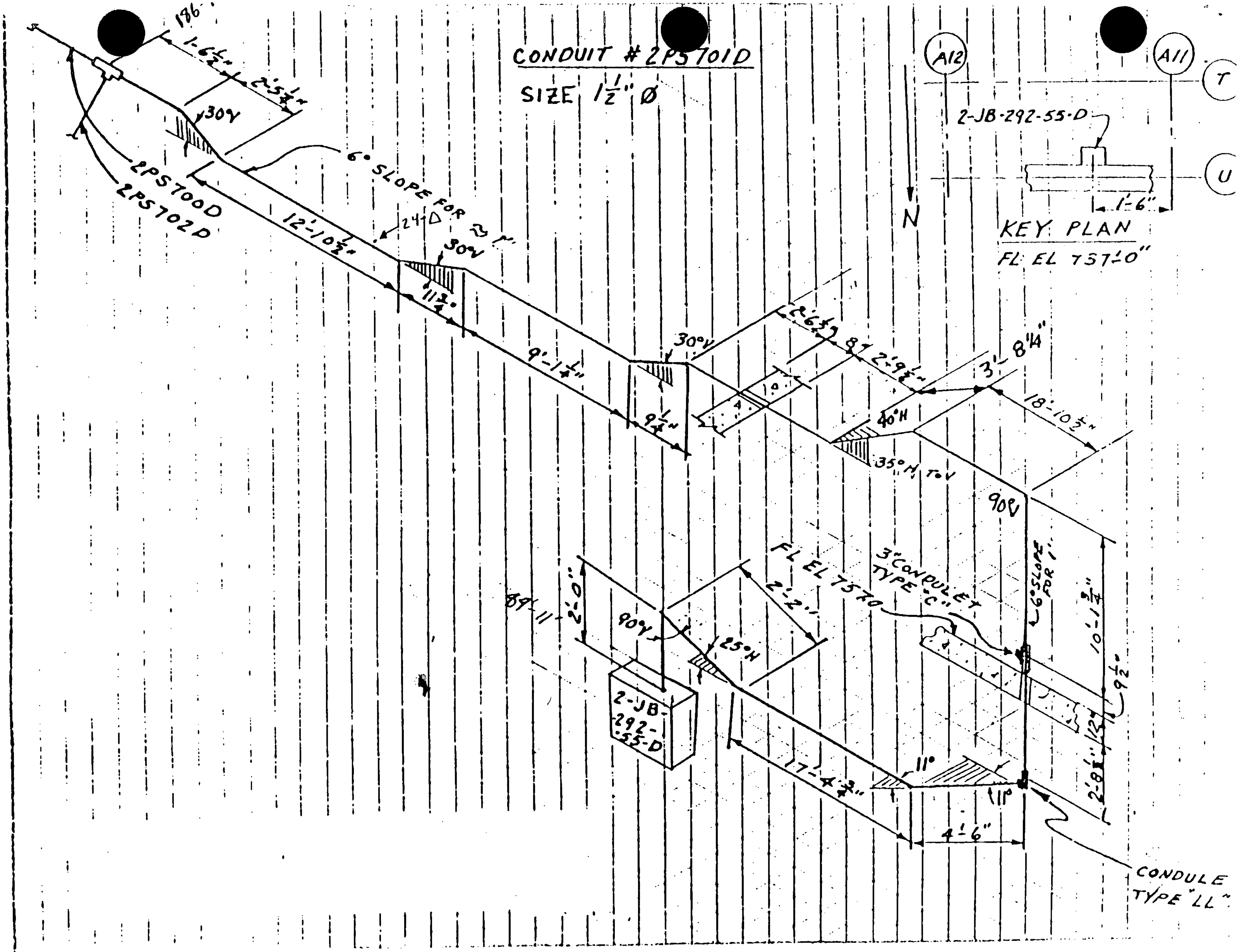


KEY PLAN
FL. EL. 757-0"
MATCH LINE "A"
A12211
A11900
17-
PULL POINTS "A"
138'-7"
2-JB-292-1444D
28'-6½"
21'-4"
4'-3"
19"
3'-6"
3'-11"
11½"
10-□, 13-■, 15-△
17-⊗, 3-●, 21-⊗
20-□, 11-X, 12-□
5'-10½"
PULL POINTS "C"
227'-8"
2-JB-1637D
13¾"
4'-7½"
3'-3"
23½"
20°
PULL POINTS "B"
MATCH LINE "A"
A12255
A12311
COND. # 2PM6470D

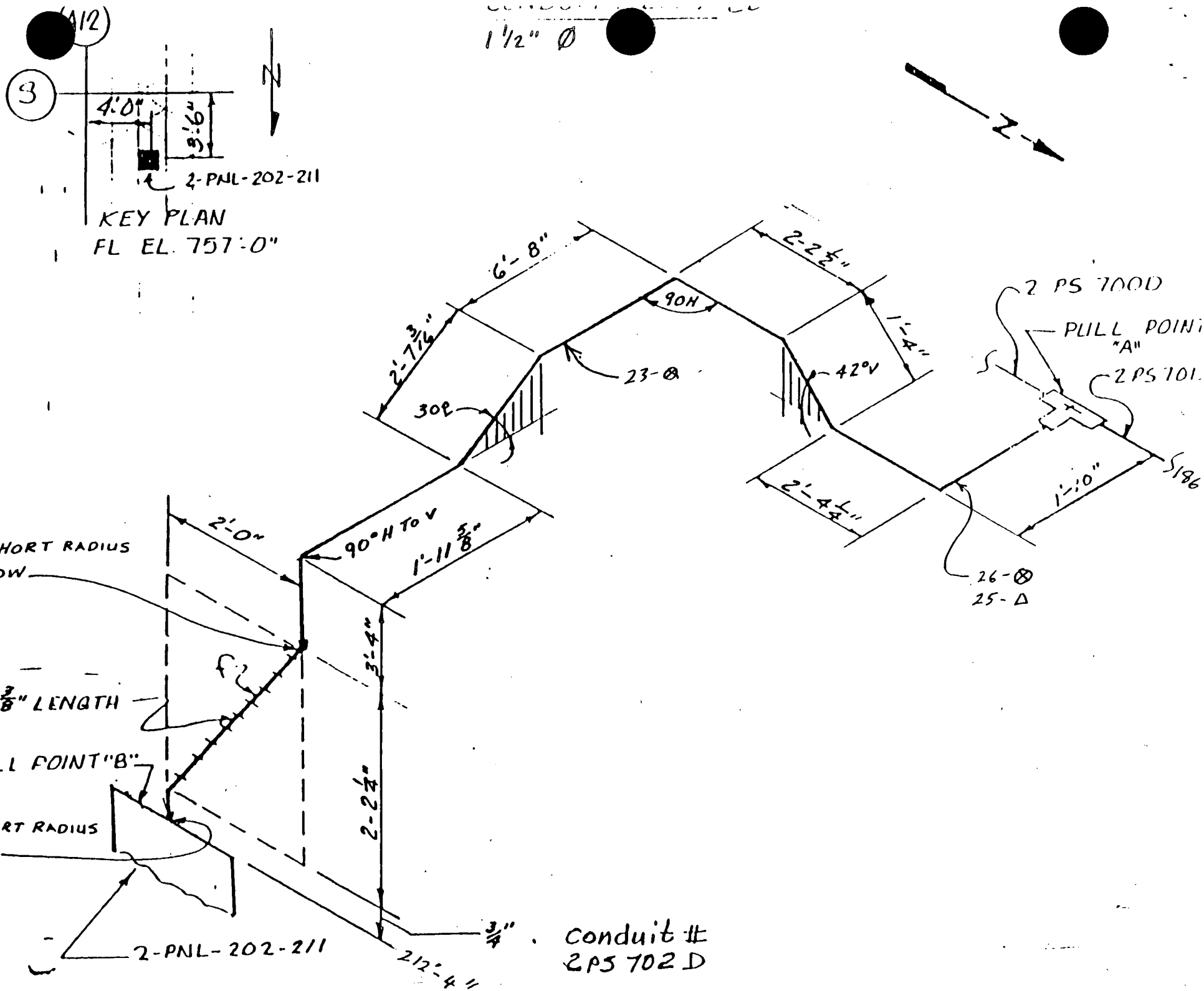

A12
A11
T
U
2-JB-292-55-D
1'-6"
N
LOCATION PLAN
EL 749'-6"
REL 737'-0"
2-JB-1144-D
EL 757'
(CEILING)
16-
12-
13-
7-
35%
15°H
135'-7"
17-
7-
6-
120V
90°V-N
3'-0"
EL 780'-6"
A11
PRESSURE SEAL
14'-9"
2'-1½"
7-
3'-2½"
45°V
7-
1'-11½"
4'-3¾"
EMBEDDED CONDUIT (ASSUMED CONFIGURATION)
2-JB-292-55-D
EL 749'6"
A11
PULL POINT 'A'
3'-0"
21-
20-
90V-N
91'-6"
7-
21-
13-
4-
CONDUIT # 2PM 6473D
U

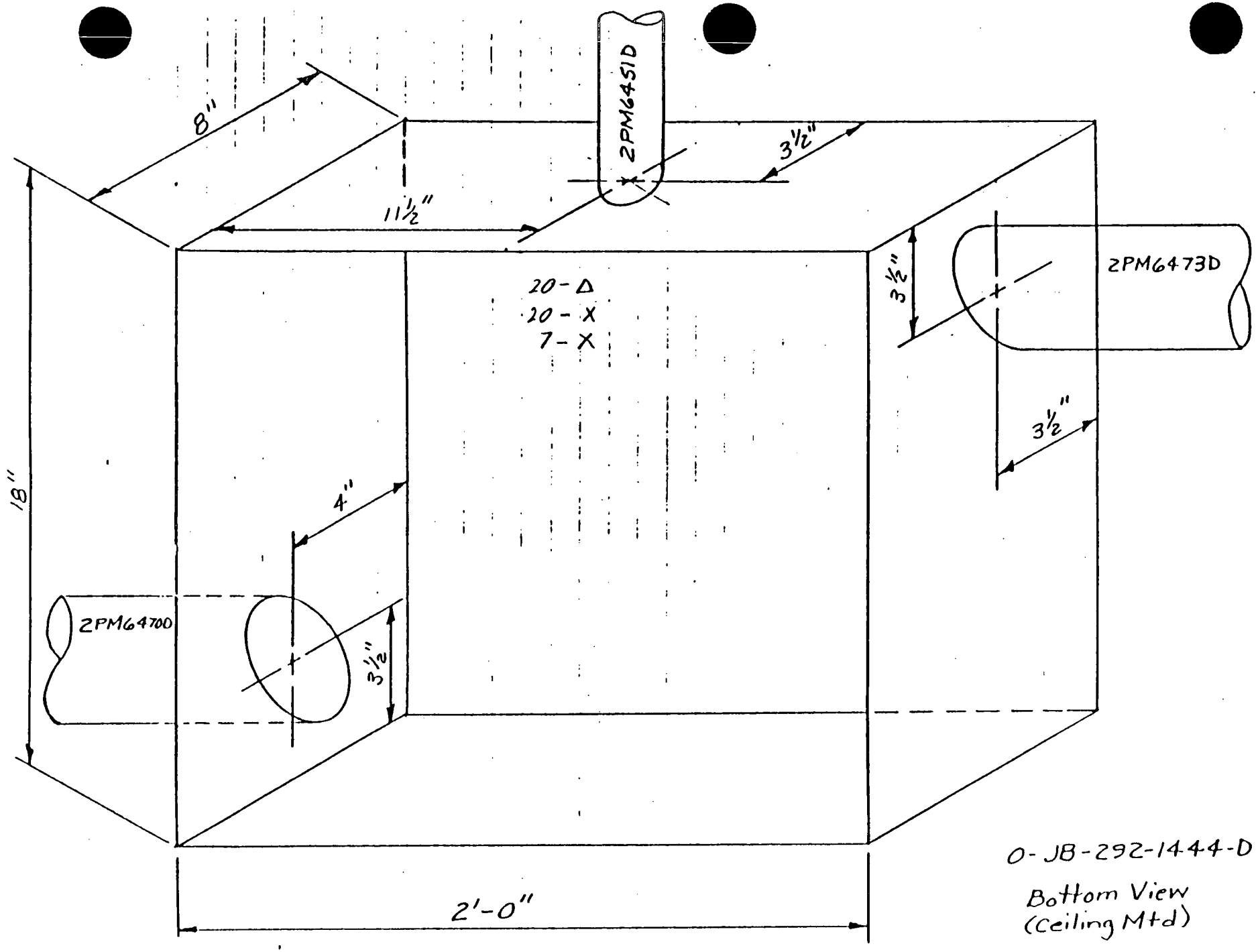


A12
A11
T
U
N
JB 550
1'-6"
LOCATION PLAN
EL 749'-6"
FL EL 737'
6'-3 1/2"
22'-2"
19"
3'-8"
3'-1/2"
90°
39°
30°
5-★
2'-8"
2-★
49'-1"
8-★
125°
13-Δ
14-⊗
10-Δ,6-Δ
9-Δ
17-★
10-Δ,13-Δ,
25-□
4-Δ
25°
U
A11
2-JB-292-55-D
EL 749'-6"
FL EL 737'-0"
★ THE SECTION OF CONDUIT FROM PULL POINT A TO PULL POINT B WAS PARTIALLY REMOVED AND PLACED ON THE FLOOR. CONDUIT CONFIGURATION IS APPROXIMATED.
15'-0"
4-Δ
4-Δ
5°
5°
4-⊕
EL 737'-0"
9"
AC1219
23"
12"
15"
LR
PULL POINT "B"
90°
2'-11 1/2"
8-⊗
25-#
3-Δ,22-Δ,18-★,2-★,18-Δ,22-Δ,
17-★,13-★,10-Δ,2-★,19,■,8-★
16-★,24-★,19,■,8-★
8'-0"
2'-4"
6'-1 1/2"
7-Δ
25°
2'-0"
10'-6 1/2"
15'-4"
2'-6"
10'-8"
26-★
3-Δ,22-Δ,11-★
6-Δ
20-⊗
18-Δ
4-Δ,Δ,#
18-Δ,22-Δ,14-Δ
30°
5-Δ
26-★
26-★,8-★
5-Δ
7-⊗,14-Δ
cable cut point (0-feet)
39°
PULL POINT "A"
(-)15'-
26-★
2-JB-292-1636-D
FL EL 713'-0"
A10
CONDUIT 2PM6474D



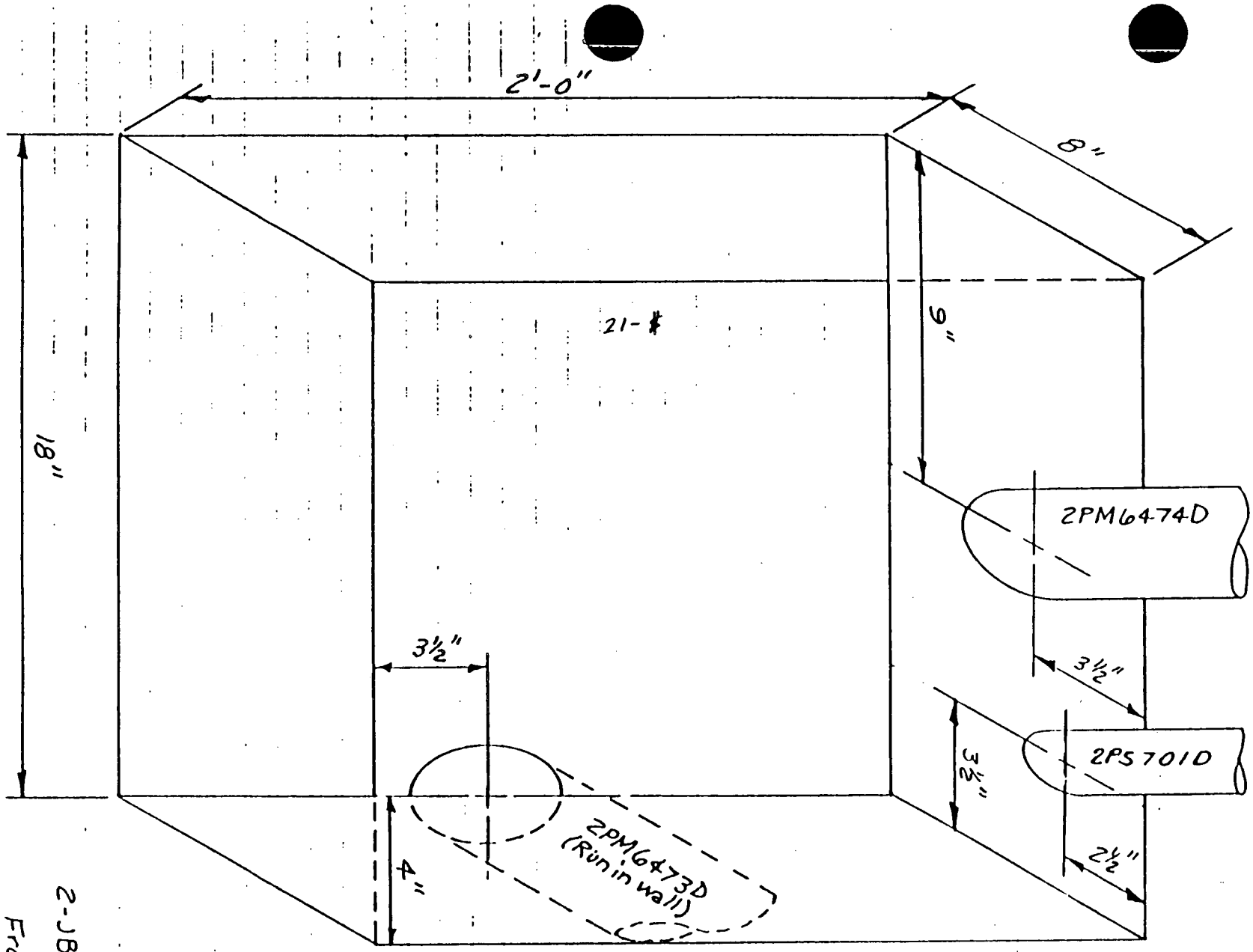
CONDUIT #2PS701D
SIZE 1 1/2" Ø
186
1'-6 1/2"
2'-5 1/4"
30°V
6° SLOPE FOR 3'-1"
2PS700D
2PS702D
12'-10 1/2"
24'-D
30°V
11 1/2"
9'-1 1/4"
30°V
9 1/4"
2'-6 1/2"
8"
2'-9 3/4"
3'-8 1/4"
18'-10 1/2"
40°H
35°H TO V
90°V
A12
A11
T
U
2-JB-292-55-D
1'-6"
N
KEY PLAN
FL EL 757'-0"
FL EL 757'-0"
3" CONDULET TYPE "C"
6° SLOPE FOR 1'
2'-2"
2'-0"
90°V
25°H
2-JB-292-55-D
10'-1 3/4"
9 1/2"
12"
2'-8 1/4"
17'-4 3/4"
11°
11°
4'-6"
CONDULE TYPE "LL"


(12)
3
4'-0"
3'-6"
N
2-PNL-202-211
KEY PLAN
FL EL 757'-0"
1 1/2" Ø
N
6'-8"
2'-7 3/16"
90H
2-2 1/2"
1'-4"
23-⊗
42°V
30Ø
2 PS 700D
PULL POINT "A"
2 PS 701
S186
1'-0"
2'-4 1/2"
26-⊗
25-Δ
2'-0"
90° H TO V
1'-11 5/8"
45° SHORT RADIUS ELBOW
3'-4"
3'-0 3/8" LENGTH
PULL POINT "B"
45° SHORT RADIUS ELBOW
2-2 1/2"
2-PNL-202-211
2 1/2"-4"
3/4" conduit #
2PS 702D



O-JB-292-1444-D

Bottom View
(Ceiling Mtd)



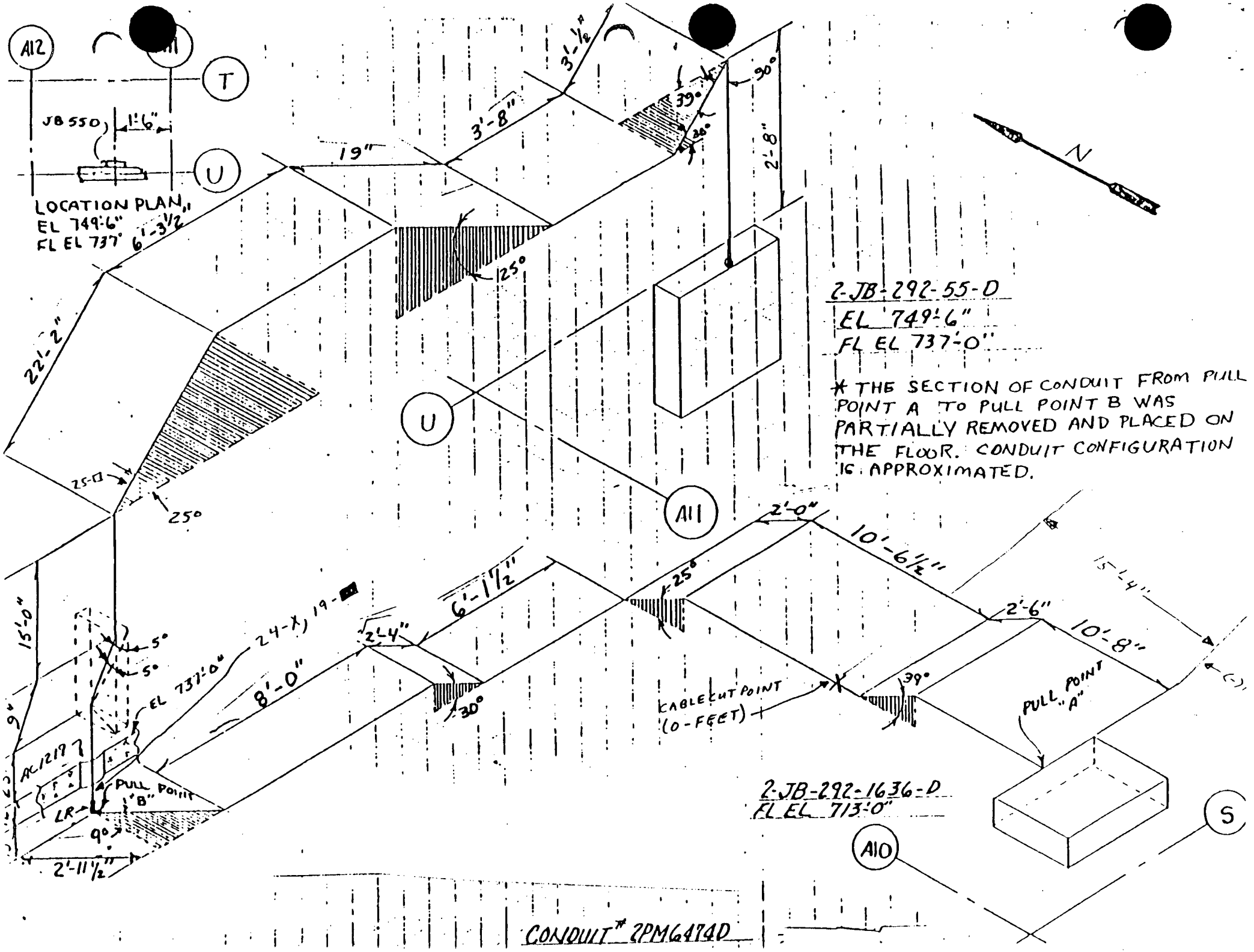
2-JB-292-55-D

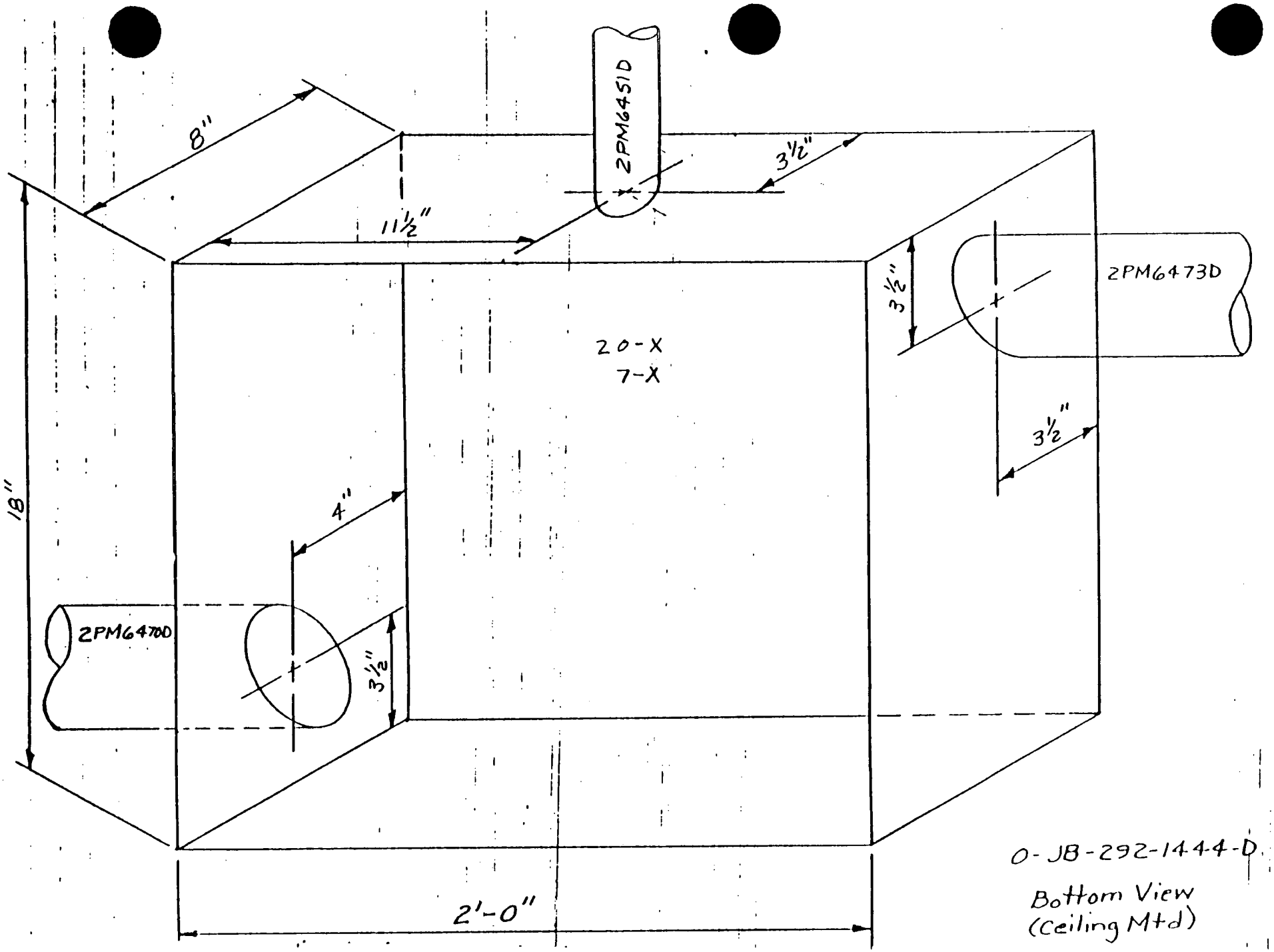
Front View

ISOMETRIC

WBN CABLE PULLBYS
KEY OVERLAYS

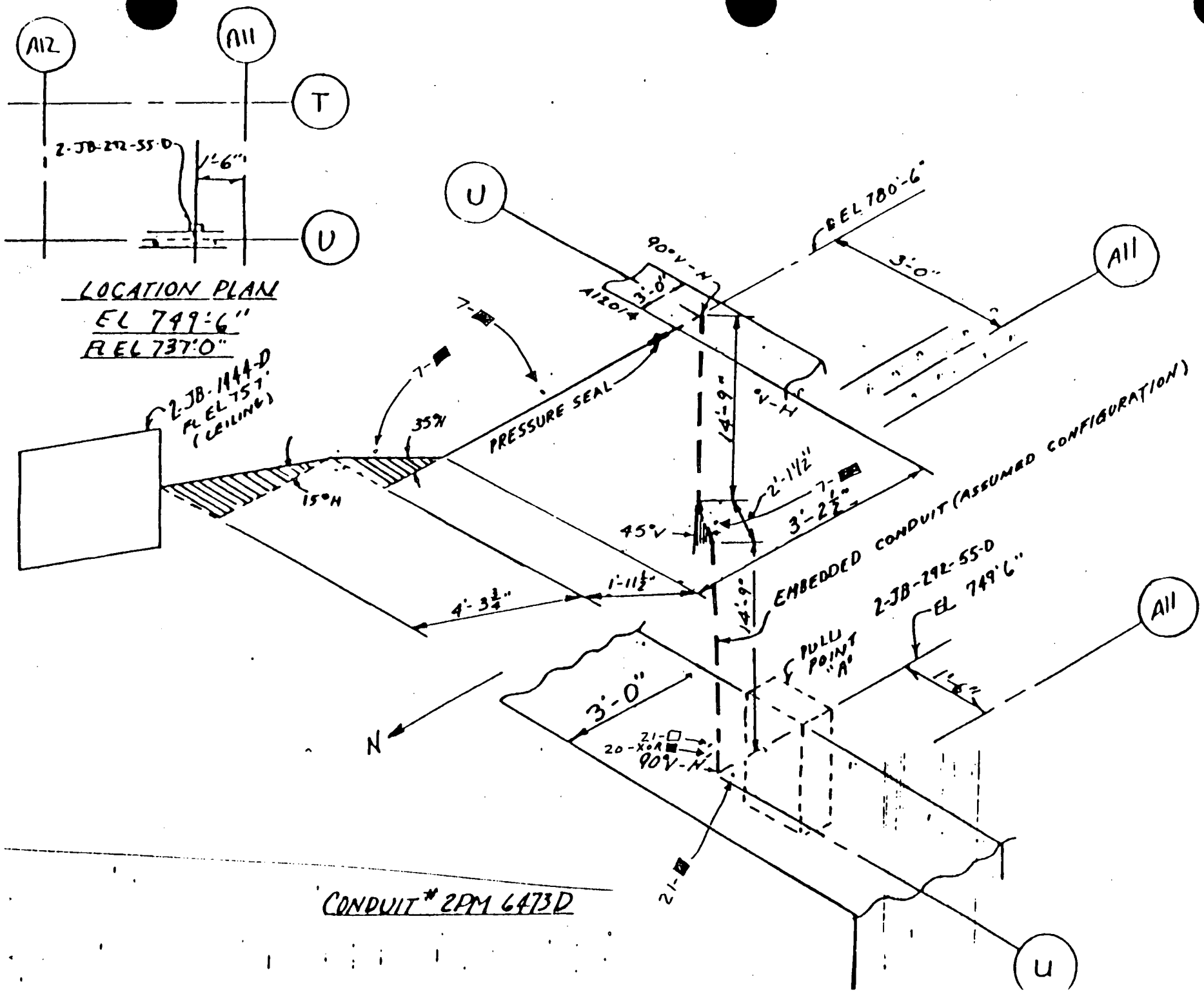
OVERLAYS WITH DAMAGE WHICH PENETRATE JACKET, SHIELD, AND INSULATION ONLY

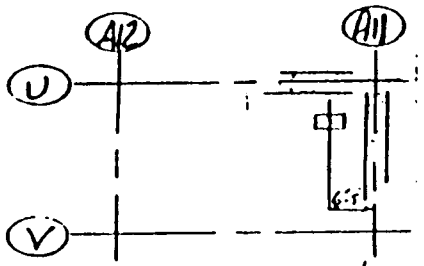

A12
T
U
JB 550
1'-6"
LOCATION PLAN
EL 749'-6"
FL EL 737'
6'-3½"
19"
3'-8"
3'-1½"
90°
39°
20°
2'-8"
N
25°
22'-2"
25-D
25°
2-JB-292-55-D
EL 749'-6"
FL EL 737'-0"
* THE SECTION OF CONDUIT FROM PULL POINT A TO PULL POINT B WAS PARTIALLY REMOVED AND PLACED ON THE FLOOR. CONDUIT CONFIGURATION IS APPROXIMATED.
A11
2'-0"
10'-6½"
25°
6'-1½"
2'-4"
15'-4"
2'-6"
10'-8"
15'-0"
5°
5°
EL 737'-0"
24-X) 19-
8'-0"
30°
39°
CABLE CUT POINT
(0-FEET)
PULL POINT "A"
9"
AC1219
PULL POINT "B"
LR
90°
2'-11½"
2-JB-292-1636-D
FL EL 713'-0"
A10
S
CONDUIT # 2PM6474D



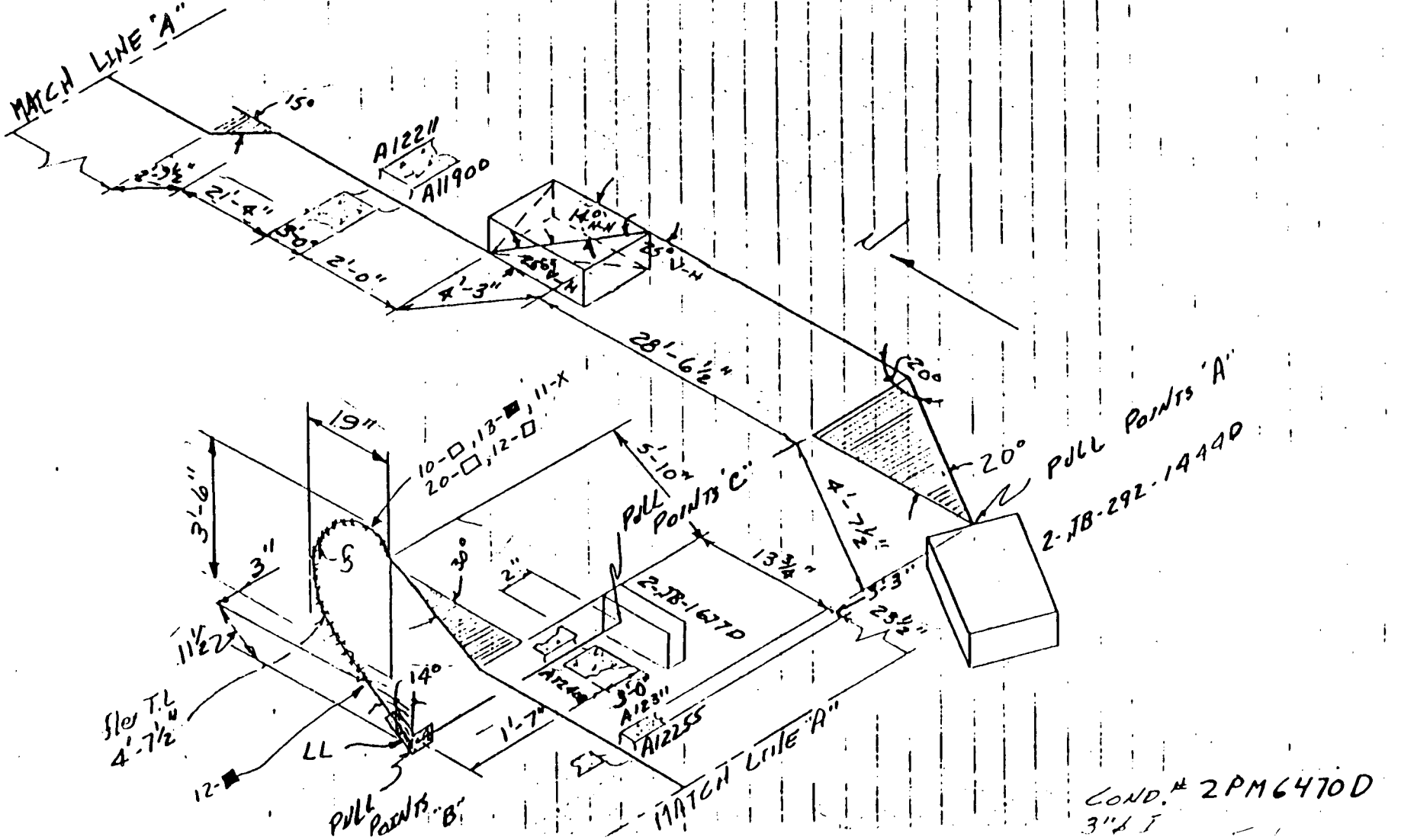
O-JB-292-1444-D

Bottom View
(Ceiling Mtd)

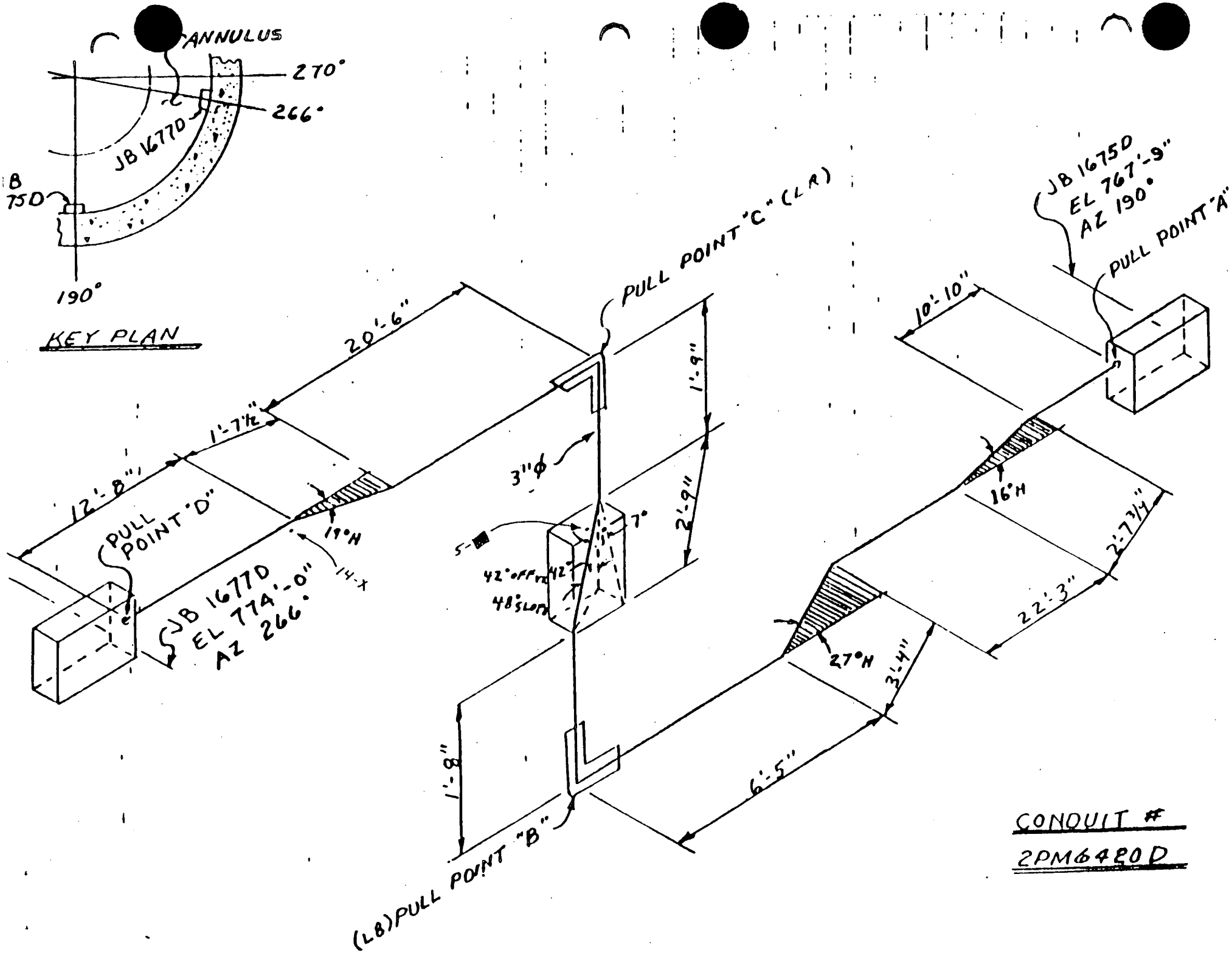

A12
A11
T
U
2-JB-292-55-D
1'-6"
LOCATION PLAN
EL 749'-6"
R EL 737'-0"
2-JB-1144-D
EL 757'
(CEILING)
7-
35°H
15°H
PRESSURE SEAL
90°V-N
A120'
3'-0"
EL 780'-6"
A11
4'-9"
2'-1½"
3'-2½"
45°V
EMBEDDED CONDUIT (ASSUMED CONFIGURATION)
1'-11½"
4'-3¾"
2-JB-292-55-D
EL 749'6"
PULL POINT "A"
3'-0"
N
21-
20-
90°V-N
CONDUIT # 2PM 6473D



KEY PLAN
FL. EL. 757'-0"

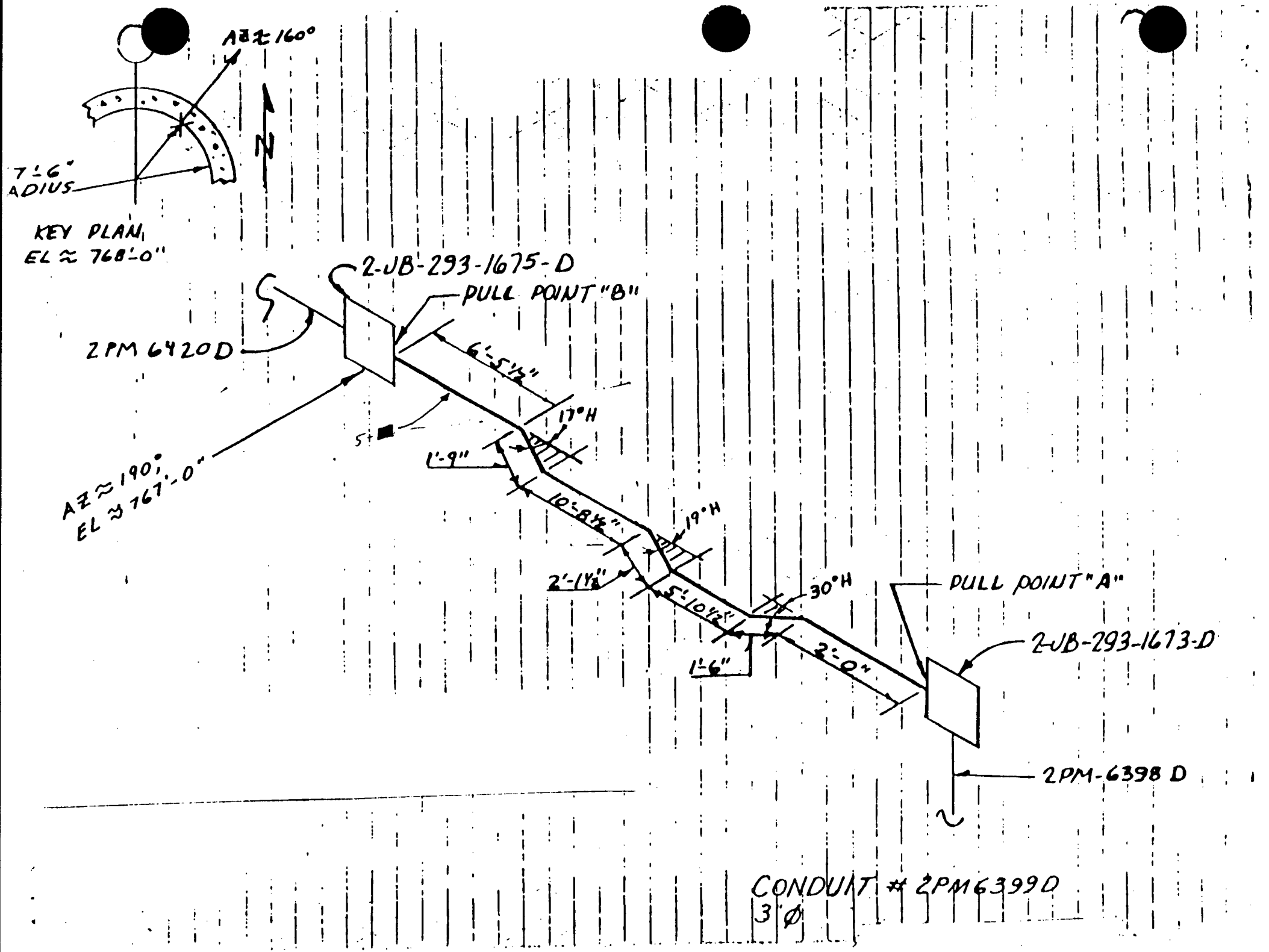


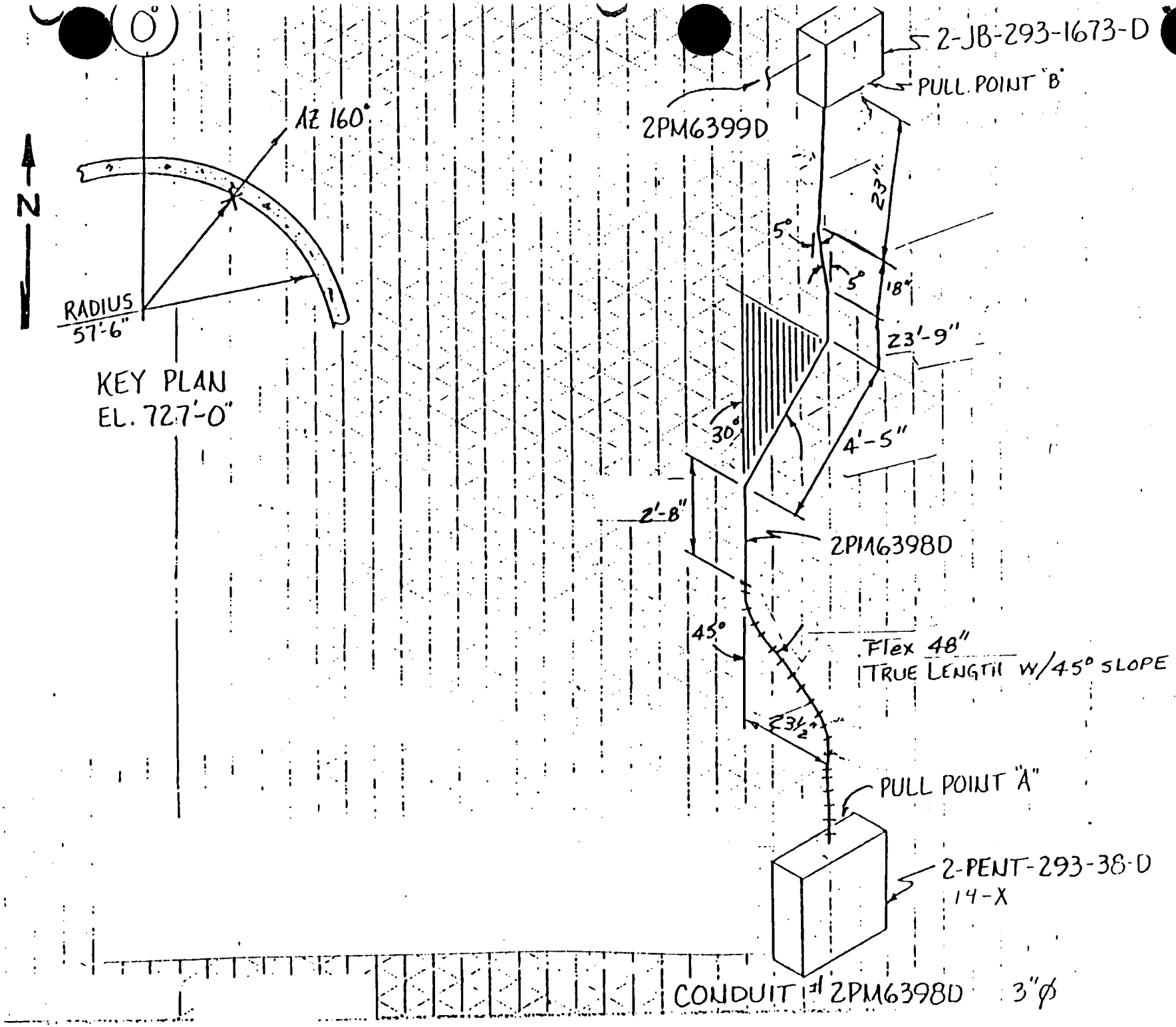
COND. # 2PM6470D
3"ϕ I



CONDUIT #

2PM6480D


AZ ≈ 160°
N
7'-6" RADIUS
KEY PLAN
EL ≈ 768'-0"
2-JB-293-1675-D
PULL POINT "B"
2PM 6420D
6'-5½"
17°H
5+
1'-9"
AZ ≈ 190°
EL ≈ 767'-0"
10'-8½"
19°H
2'-1½"
5'-10½"
30°H
PULL POINT "A"
2-JB-293-1673-D
1'-6"
2'-0"
2PM-6398 D
CONDUIT # 2PM6399D
3 Ø



NO. 1242 – 8½ X 11 35°16' ISOMETRIC

Attachment 6
Page 46

PROGRAM CBLPUL. SOFTWARE ID 262352
VERSION 2 COMPUTED WH DATE 8-8-89
CHECKED BSO DATE 8/9/89

CALCULATION OF PULL TENSIONS
AND SIDE WALL PRESSURES

WATTS BAR CALCULATION PACKAGE NUMBER 2PM6473D-9
PAGE 1

INPUT SUMMARY

CABLE(S) UNID	MARK NUMBER	MARK NUMBER DESCRIPTION	(NC)	OUTER DIAM	WEIGHT PER/FT	CIRC M AREA
2PM591D	WVC	#16 AWG 4/C	4	0.447	0.113	25
2PM1314D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1454D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1536D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1573D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1656D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1694D	WVA	#16 AWG 2/C	2	0.396	0.085	25

PULL POINTS: FROM A TO 2-TB-292-1444-D
CIRCUIT UNID: 2PM6473D NOMINAL DIAMETER: 3 INCHES
MINIMUM ALLOWABLE BEND RADIUS: .95 FEET

EXPECTED PULLING TENSION AND EXPECTED SIDEWALL PRESSURE CALCULATIONS
WILL BE PERFORMED FOR EXISTING CABLE — 'PULL-BY'
CABLE FUNCTION: MEDIUM-LEVEL / LOW-LEVEL SIGNAL CABLE
PULLING METHOD: CONNECTION TO CONDUCTOR

NUMBER OF CABLES IN PULL: 7
WEIGHT CORRECTION FACTOR: 1.4
TOTAL CABLE WEIGHT: .623 LBS/FT
INPUT COEFFICIENT OF FRICTION: .75
COEFFICIENT OF PULLING FRICTION: 1.05

CALCULATION OF PULL TENSIONS AND SIDE WALL PRESSURES

COMPUTED ___ DATE ___
CHECKED BSD DATE 8/6

WATTS BAR CALCULATION PACKAGE NUMBER 2PM6473D-9
PAGE 2

FORWARD PULL ← FROM JB 55 TO JB 1444

SEG NUM	SEGMENT TYPE	LENGTH IN FT	ANGLE FROM HORIZ	BEND ANGLE	PULLING TENSION IN LBS	SIDEWALL PRESSURE IN LBS
1	HORIZONTAL	1.50	0.00	0.00	0.98	
2	BEND. H-V UP	0.00	0.00	90.00	4.36	3.22
3	INCLINED UP	14.75	90.00	0.00	13.55	
4	BEND. V UP-H	0.00	0.00	45.00	31.89	23.50
5	INCLINED UP	2.13	45.00	0.00	33.81	
6	BEND. H-V UP	0.00	0.00	45.00	76.67	56.49
7	INCLINED UP	14.75	90.00	0.00	85.86	
8	BEND. V UP-H	0.00	0.00	90.00	449.80	331.43
9	HORIZONTAL	3.21	0.00	0.00	451.90	
10	H BEND	0.00	0.00	35.00	858.24	632.38
11	HORIZONTAL	1.96	0.00	0.00	859.52	
12	H BEND	0.00	0.00	15.00	1131.46	833.70
13	HORIZONTAL	4.31	0.00	0.00	1134.28	

TAL OF BEND ANGLES IN PULL: 320.00 DEGREES

MAXIMUM EXPECTED PULLING TENSION (Texp): 1134.28 LBS/FT
MAXIMUM EXPECTED SIDEWALL PRESSURE (SWPexp): 833.70 LBS/FT
MAXIMUM EXPECTED TENSION FOR FIGURING SIDEWALL PRESSURE: 1131.46 LBS

APPROXIMATE DAMAGE LOCATION

Attachment 6
Page 48

CALCULATION OF PULL TENSIONS AND SIDE WALL PRESSURES CHECKED RSD DATE 8/6

WATTS BAR CALCULATION PACKAGE NUMBER [illegible]
PAGE 2

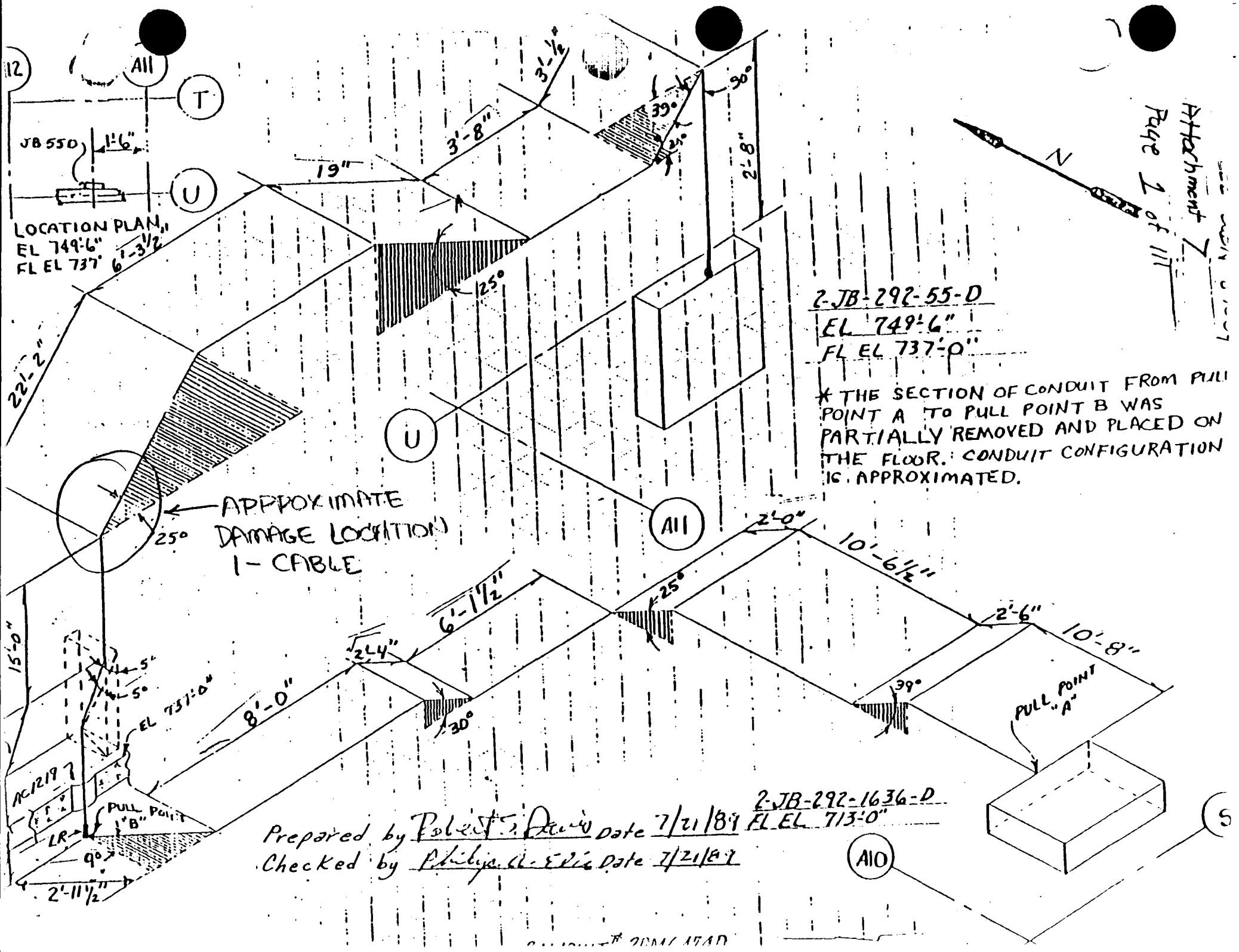
From JB 1444 TO JB 55

REVERSE PULL ←

SEG NUM	TENSION IN LBS	PRESSURE IN LBS	
13	2.82		
12	3.71	2.73	
11	4.99		
10	9.48	6.99	
9	11.58		
8	61.02	44.96	
7	51.83		
6	117.25	86.40	
5	117.30		
4	268.03	197.50	
3	258.84		
2	1343.85	990.21	← APPROXIMATE DAMAGE LOCATIO
1	1344.83		

MUM PULLING TENSION ON REVERSE PULL (Texp): 1344.83 LBS/FT
(TENSION OF 1134.28 LBS FOR FORWARD PULL)

MAXIMUM SIDEWALL PRESSURE ON REVERSE PULL (SWPexp): 990.21 LBS/FT
(SIDEWALL PRESSURE OF 833.70 LBS FOR FORWARD PULL)
MAXIMUM TENSION FOR SIDEWALL PRESSURE ON REVERSE PULL: 1343.85 LBS


12
A11
T
U
JB 550
1'-6"
LOCATION PLAN
EL 749'-6"
FL EL 737'
6'-3½"
19"
3'-8"
3'-½"
39°
30°
2'-8"
N
2-JB-292-55-D
EL 749'-6"
FL EL 737'-0"
* THE SECTION OF CONDUIT FROM PULL POINT A TO PULL POINT B WAS PARTIALLY REMOVED AND PLACED ON THE FLOOR. CONDUIT CONFIGURATION IS APPROXIMATED.
25°
22'-2"
APPROXIMATE DAMAGE LOCATION
1 - CABLE
A11
2'-0"
10'-6½"
6'-1½"
25°
2'-6"
10'-8"
15'-0"
5"
5°
EL 731'-0"
8'-0"
24"
30°
39°
PULL POINT "A"
AC12197
PULL POINT "B"
LR
90°
2'-11½"
2-JB-292-1636-D
FL EL 713'-0"
A10
Prepared by [illegible] Date 7/21/81
Checked by [illegible] Date 7/21/81

Q1R LEE WBN 89004
Attachment 7
Page 84

PROGRAM CBLPUL. SOFTWARE ID 262352
VERSION 2
COMPUTED WH DATE 8-8-89
CHECKED RSD DATE 8/23/8

CALCULATION OF PULL TENSIONS
AND SIDE WALL PRESSURES

WATTS BAR CALCULATION PACKAGE NUMBER 2PM6474D-9 B
PAGE 1

INPUT SUMMARY

CABLE(S) UNID	MARK NUMBER	MARK NUMBER DESCRIPTION	(NC)	OUTER DIAM	WEIGHT PER/FT	CIRC MI AREA
2PM591D	WVC	#16 AWG 4/C	4	0.447	0.113	25
2PM1314D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1454D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1536D	WVA	#16 AWG 2/C	2	0.396	0.085	25
2PM1573D	WVA	#16 AWG 2/C	2	0.396	0.085	25
M1656D	WVA	#16 AWG 2/C	2	0.396	0.085	25
M1694D	WVA	#16 AWG 2/C	2	0.396	0.085	25

POINTS: FROM B TO 2-IB-292-55-D
UIT UNID: 2PM6474D NOMINAL DIAMETER: 3 INCHES
IMUM ALLOWABLE BEND RADIUS: .95 FEET

EXPECTED PULLING TENSION AND EXPECTED SIDEWALL PRESSURE CALCULATIONS
WILL BE PERFORMED FOR EXISTING CABLE -- 'PULL-BY'
CABLE FUNCTION: MEDIUM-LEVEL / LOW-LEVEL SIGNAL CABLE
PULLING METHOD: CONNECTION TO CONDUCTOR

NUMBER OF CABLES IN PULL: 7
WEIGHT CORRECTION FACTOR: 1.4
TOTAL CABLE WEIGHT: .623 LBS/FT
INPUT COEFFICIENT OF FRICTION: .75
COEFFICIENT OF PULLING FRICTION: 1.05

QIR LEEWBN940004
Attachment 7
Page 85

COMPUTED WJF DATE 8-9-9
CHECKED RSO DATE 8/23/

CALCULATION OF PULL TENSIONS AND SIDE WALL PRESSURES

WATTS BAR CALCULATION PACKAGE NUMBER 2PM6474D-9 B
PAGE 2

FORWARD PULL

SEG NUM	SEGMENT TYPE	LENGTH IN FT	ANGLE FROM HORIZ	BEND ANGLE	PULLING TENSION IN LBS	SIDEWALL PRESSURE IN LBS
1	INCLINED UP	4.17	90.00	0.00	2.60	
2	BEND, V UP-H	0.00	0.00	5.00	2.91	2.14
3	INCLINED UP	0.75	85.00	0.00	3.41	
4	BEND, H-V UP	0.00	0.00	5.00	3.69	2.72
5	INCLINED UP	15.00	90.00	0.00	13.03	
6	BEND, V UP-H	0.00	0.00	90.00	70.86	52.22
7	HORIZONTAL	22.17	0.00	0.00	85.37	
8	H BEND	0.00	0.00	25.00	134.98	99.46
9	HORIZONTAL	6.29	0.00	0.00	139.09	
10	BEND, H-V DN	0.00	0.00	25.00	220.19	162.25
11	INCLINED DN	1.58	25.00	0.00	220.71	
12	BEND, V DN-H	0.00	0.00	25.00	348.57	256.84
13	HORIZONTAL	3.67	0.00	0.00	350.97	
14	H BEND	0.00	0.00	30.00	608.19	448.14
15	HORIZONTAL	3.04	0.00	0.00	610.18	
16	BEND, H-V DN	0.00	0.00	90.00	3175.81	2340.07
17	INCLINED DN	2.67	90.00	0.00	3174.15	

IN THIS SUBSEGMENT ONLY

TOTAL OF BEND ANGLES IN PULL: 295.00 DEGREES

MAXIMUM EXPECTED PULLING TENSION (Texp): 3175.81 LBS/FT
MAXIMUM EXPECTED SIDEWALL PRESSURE (SWPexp): 2340.07 LBS/FT
MAXIMUM EXPECTED TENSION FOR FIGURING SIDEWALL PRESSURE: 3175.81 LBS

APPROXIMATE DAMAGE LOCATION

QIR LEE WBN 94004

Attachment 7

Page 86

COMPUTED WJ DATE 8-8-

CALCULATION OF PULL TENSIONS AND SIDE WALL PRESSURES CHECKED RSO DATE 8/23

WATTS BAR CALCULATION PACKAGE NUMBER 2PM6474D-9 B

REVERSE PULL

SEG NUM	TENSION IN LBS	PRESSURE IN LBS	
17	1.66		
16	11.70	8.62	
15	13.69		
14	23.73	17.48	
13	26.13		
12	41.04	30.24	
11	42.39		
10	67.44	49.69	
9	71.55		
8	113.13	83.36	← APPROXIMATE DAMAGE LOCATION
7	127.63		
6	664.89	489.92	
5	655.55		
4	718.39	529.34	
3	717.97		
2	786.92	579.84	
1	784.32		

MAXIMUM PULLING TENSION ON REVERSE PULL (Texp): 786.92 LBS/FT
(TENSION OF 3175.81 LBS FOR FORWARD PULL)

MAXIMUM SIDEWALL PRESSURE ON REVERSE PULL (SWPexp): 579.84 LBS/FT
(SIDEWALL PRESSURE OF 2340.07 LBS FOR FORWARD PULL)

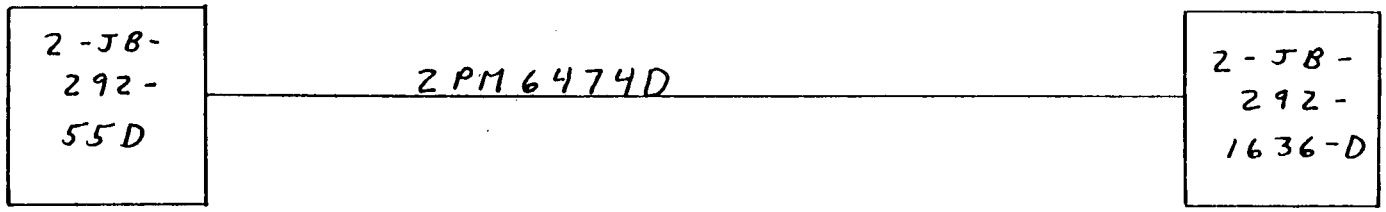
MAXIMUM TENSION FOR SIDEWALL PRESSURE ON REVERSE PULL: 786.92 LBS

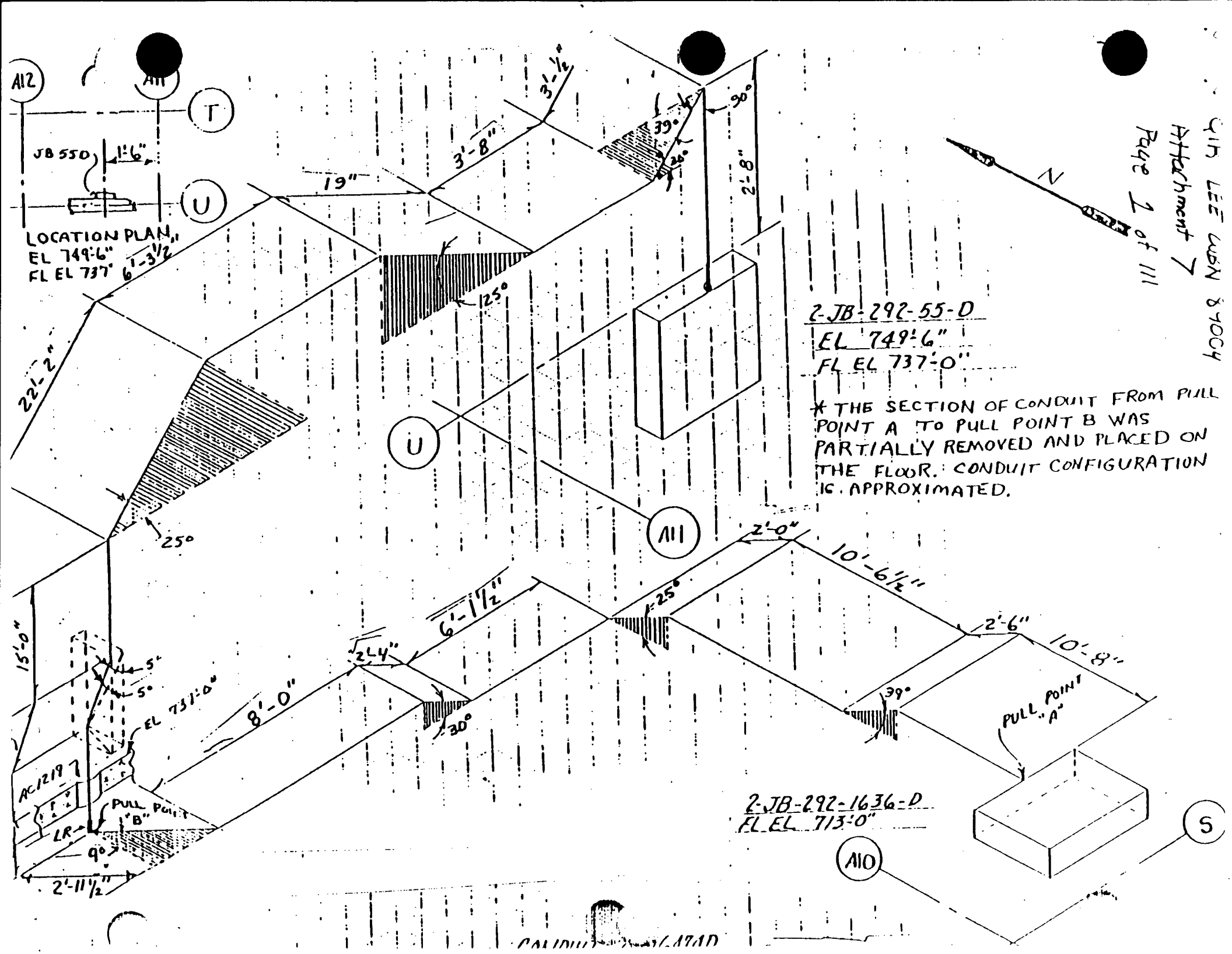
DEVELOPMENT OF KEY OVERLAYS

- A walkdown was performed to determine the exact configuration of the conduits and prepare conduit sketches.
- Hand-over-hand inspection was performed to identify types of damage points with a reference point of the conduit bushing on conduit 2PM6474D in junction box 2-JB-292-1636-D.
- Assigned a unique number to identify each cable.
- Prepared a list of symbols to represent categories of damage.
- Using dimensions from sketches and dimensions from hand-over-hand inspection, overlaid cable damage on sketches.

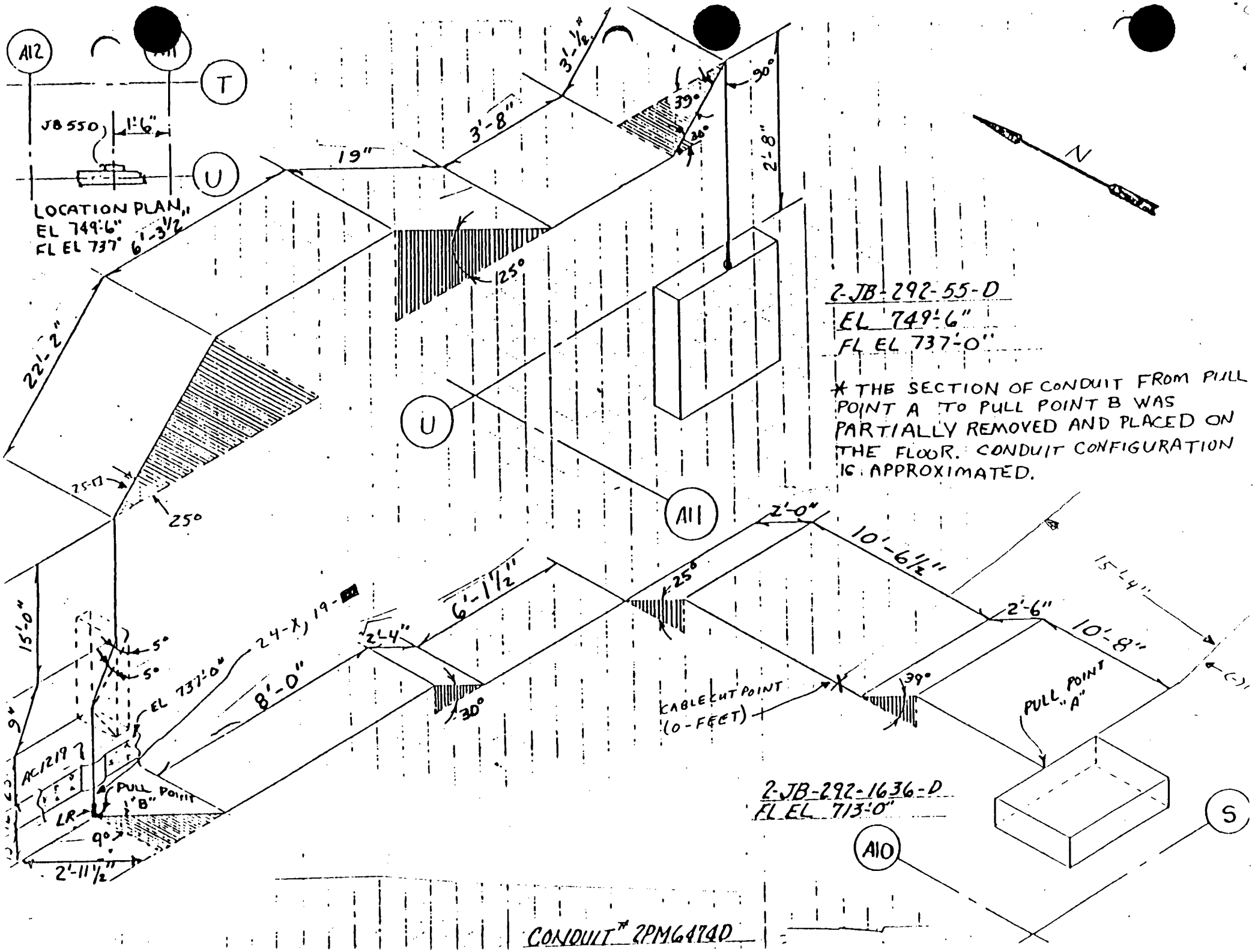
CABLE PULLING CAQ

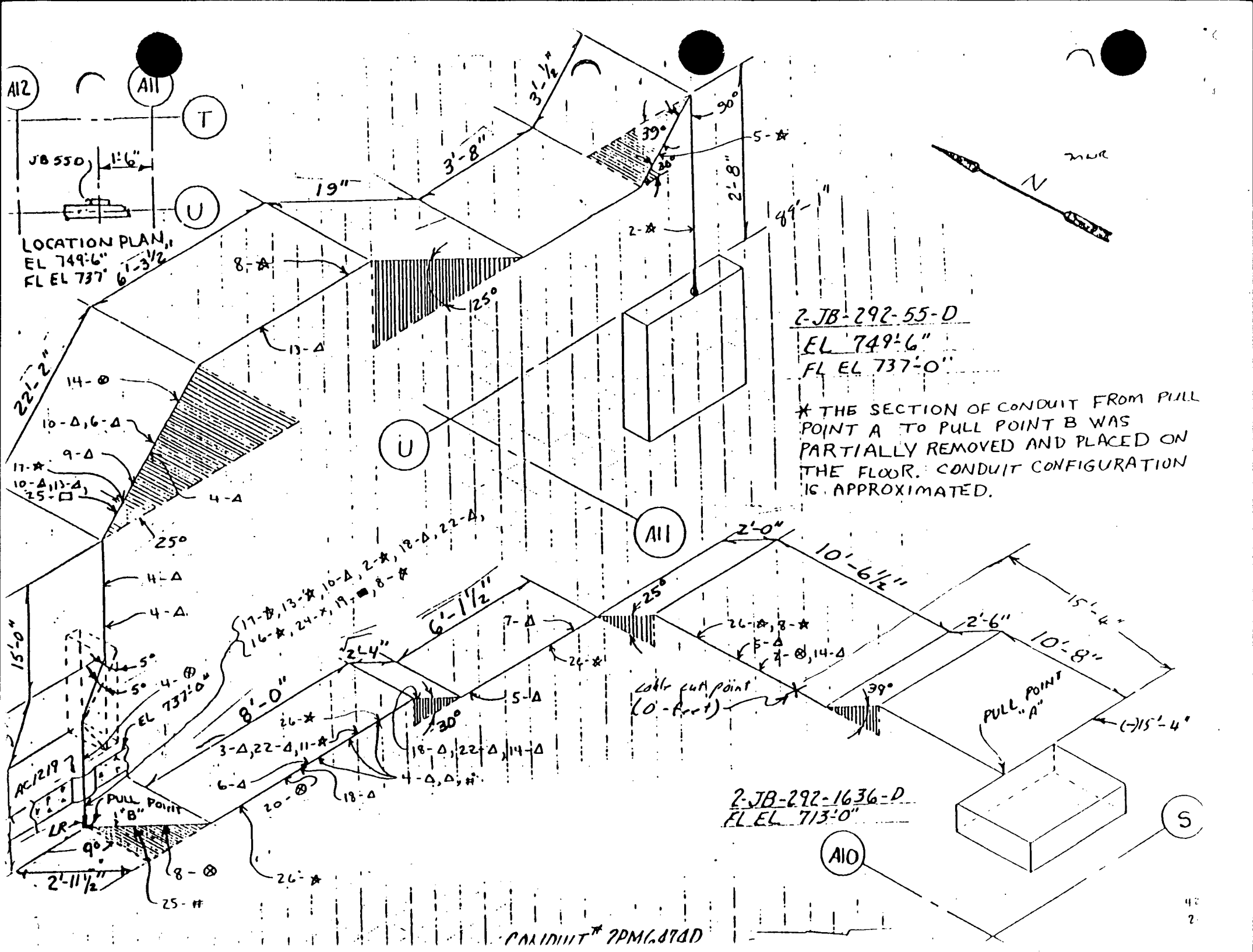
	CABLE NO	INBOARD CABLE NUMBER	MARK NO	SIZE	FROM DEVICE	TO DEVICE #1	TO DEVICE #2	FUNCTION	DESIGN LENGTH	CONTRACT	TYPE OF DAMAGE	REQD Y/N	WI RECORD NUMBER
1	2-2PH-1-1314-D	2PH1313D	VVA	1-2C#16	2-PNL-99-R3	2-PENT-293-30-D	2-FT-1-3A	S.G. 1 STM FLOW CH. 1	622	025052		N	1
2	2-2PH-1-1454-D	2PH1453D	VVA	1-2C#16	2-PNL-99-R3	2-PENT-293-30-D	2-FT-1-10A	S.G. 2 STM FLOW CH. 1	622	025052		N	2
3	2-2PH-1-1573-D	2PH1572D	VVA	1-2C#16	2-PNL-99-R4	2-PENT-293-30-D	2-FT-1-21A	S.G. 3 STM FLOW CH. 1	622	025052		N	3
4	2-2PH-1-1694-D	2PH1693D	VVA	1-2C#16	2-PNL-99-R4	2-PENT-293-30-D	2-FT-1-28A	S.G. 4 STM FLOW CH. 1	622	025052		N	4
5	2-2PH-3-1536-D	2PH1535D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-LT-3-51	STEAM GEN 2 LEVEL	622	025052		N	5
6	2-2PH-3-1656-D	2PH1655D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-LT-3-93	STEAM GEN 3 LEVEL	622	025052		N	6
7	2-2PH-47-2035-D	NA	VVE	1-2C#16	2-PNL-99-R4	2-PNL-99-L116	IPT/505D(FOXBO	REAC TRIP STAT/STM DMP V	482	024447		N	7
8	2-2PH-63-4701-D	2PH4700D	VVA	1-2C#16	2-PNL-99-R4	2-PENT-293-30-D	2-LT-63-100-D	CONTAINMNT LVL RHR RECIR	482	024060		N	8
9	2-2PH-68-1041-D	2PH1040D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-LT-68-339	RCS PRESSURIZER LEVEL	497	025052		N	9
10	2-2PH-68 506-D	2PH505D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-2A	RCS LP 1 HL RTD NAR TEMP	462	024447		N	10
11	2-2PH-68-508-D	2PH507D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-14B	RCS LP 1 HL RTD NAR TEMP	462	024447		N	11
12	2-2PH-68-516-D	2PH515D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-2B	RCS LP 1 HL RTD NAR TEMP	662	024447		N	12
13	2-2PH-68-518-D	2PH517D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-14A	RCS LP 1 HL RTD NAR TEMP	622	024447		N	13
14	2-2PH-68-591-D	2PH590D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-1	RCS LOOP 1 TEMP	622	07232		N	14
15	2-2PH-68-606-D	2PH605D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-FT-68-6A	RCS LOOP 1 COOLANT FLOW	622	025052		N	15
16	2-2PH-68-686-D	2PH685D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-24	RCS LOOP 2 TEMP	622	024447		N	16
17	2-2PH-68-696-D	2PH695D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-FT-68-29A	RCS LOOP 2 COOLANT FLOW	622	025052		N	17
18	2-2PH-68-778-D	2PH594D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-18	RCS LOOP 1 TEMP	622	024447		N	18
19	2-2PH-68-791-D	2PH790D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-FT-68-40A	RCS LOOP 3 COOLANT FLOW	622	025052		N	19
20	2-2PH-68-871-D	2PH690D	VVC	1-4C#16	2-PNL-99-R2	2-PENT-293-30-D	2-TE-68-41	RCS LOOP 1 TEMP	622	024447		N	20
21	2-2PH-68-881-D	2PH880D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-FT-68-71A	RCS LOOP 4 COOLANT FLOW	622	025052		N	21
22	2-2PH-68-950-D	2PH949D	VVA	1-2C#16	2-PNL-99-R1	2-PENT-293-30-D	2-PT-68-340	RCS PRESSURIZER PRESSURE	622	025052		N	22
23	2-2PS-68-282-D	NA	VHB-1	1-2C#14	2-PNL-282-2/1A	2-JB-290-3404-D	2-HS-68-343	RCP 1 UV & UF CONT	361	025342-2		N	23
24	2-2PS-68-283-D	NA	VHB-1	1-2C#14	2-PNL-282-2/1A	2-JB-290-3404-D	2-HS-68-344	RCP 1 UV & UF CONT	361	025342-2		N	24
25	2-2PS-68-284-D	NA	VHB-1	1-2C#14	2-PNL-282-2/1A	2-JB-290-3404-D	2-HS-68-343	RCP 1 UV & UF CONT	361	025342-2		N	25
26	2-2PS-68-285-D	NA	VHB-1	1-2C#14	2-PNL-282-2/1A	2-JB-290-3404-D	2-HS-68-344	RCP 1 UV & UF CONT	361	025342-2		N	26


2-JB-292-55D
2PM6474D
2-JB-292-1636-D



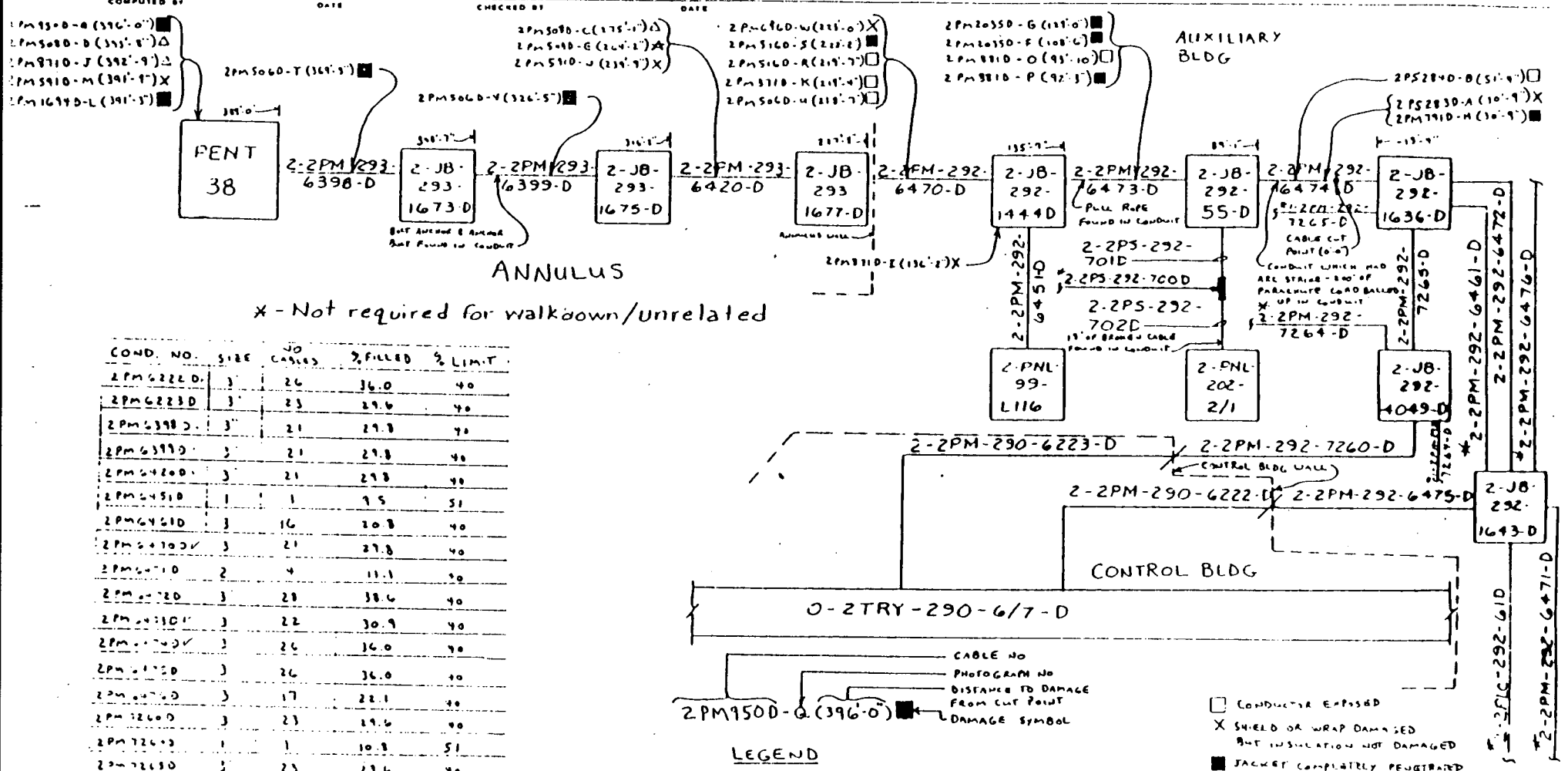
Attachment 7
Page 1 of 111


A12
T
U
JB 550
1'-6"
LOCATION PLAN
EL 749'-6"
FL EL 737'
6'-3 1/2"
3'-1 1/2"
3'-8"
19"
39°
30°
90°
2'-8"
N
125°
22'-2"
U
2-JB-292-55-D
EL 749'-6"
FL EL 737'-0"
* THE SECTION OF CONDUIT FROM PULL POINT A TO PULL POINT B WAS PARTIALLY REMOVED AND PLACED ON THE FLOOR. CONDUIT CONFIGURATION IS APPROXIMATED.
25°
25°
A11
2'-0"
10'-6 1/2"
15'-4"
2'-6"
10'-8"
6'-1 1/2"
25°
15'-0"
5°
5°
EL 737'-0"
24-X) 19-
8'-0"
2'-4"
30°
9"
AC12197
LR
PULL POINT "B"
90°
2'-11 1/2"
CABLE CUT POINT (0-FEET)
39°
PULL POINT "A"
2-JB-292-1636-D
FL EL 713'-0"
A10
S
CONDUIT # 2PM64740


A12
A11
T
U
JB 550
1'-6"
LOCATION PLAN
EL 749'-6"
FL EL 737'
6'-3 1/2"
19"
3'-8"
3'-1 1/2"
90°
39°
5-☆
2'-8"
49'-1"
2-☆
8-☆
25°
13-Δ
22'-2"
14-⊗
10-Δ, 6-Δ
9-Δ
17-☆
10-Δ, 13-Δ
25-□
4-Δ
25°
4-Δ
4-Δ
15'-0"
5°
5°
4-⊕
EL 737'-0"
AC/12197
LR
9°
2'-11 1/2"
PULL POINT "B"
8-⊗
25-#
26-☆
8'-0"
3-Δ, 22-Δ, 11-☆
6-Δ
20-⊗
18-Δ
17-☆, 13-☆, 10-Δ, 2-☆, 18-Δ, 22-Δ,
16-☆, 24-☆, 19-■, 8-☆
6'-1 1/2"
24"
7-Δ
24-☆
5-Δ
30°
18-Δ, 22-Δ, 14-Δ
4-Δ, Δ, #
2'-0"
10'-6 1/2"
25°
26-☆, 8-☆
5-Δ
7-⊗, 14-Δ
39°
2'-6"
15'-4"
10'-8"
(-)15'-4"
PULL POINT "A"
2-JB-292-55-D
EL 749'-6"
FL EL 737'-0"
2-JB-292-1636-D
FL EL 713'-0"
A10
S
N
MAR
* THE SECTION OF CONDUIT FROM PULL POINT A TO PULL POINT B WAS PARTIALLY REMOVED AND PLACED ON THE FLOOR. CONDUIT CONFIGURATION IS APPROXIMATED.

SUBJECT _____ PROJECT _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



ANNULUS

X - Not required for walkdown/unrelated

COND. NO.	SIZE	NO CABLES	% FILLED	% LIMIT
2PM6222D	3"	26	36.0	40
2PM6223D	3"	23	29.6	40
2PM6398D	3"	21	29.8	40
2PM6399D	3"	21	29.8	40
2PM6420D	3"	21	29.8	40
2PM6451D	1"	1	9.5	51
2PM6461D	3"	16	20.8	40
2PM6470D	3"	21	29.8	40
2PM6471D	2"	9	11.1	40
2PM6472D	3"	28	38.6	40
2PM6473D	3"	22	30.9	40
2PM6474D	3"	26	36.0	40
2PM6476D	3"	26	36.0	40
2PM6477D	3"	17	22.1	40
2PM7260D	3"	23	29.6	40
2PM7264D	1"	1	10.8	51
2PM7265D	3"	23	29.6	40
2PM7269D	1"	1	10.8	51
2PM7269D	1"	1	10.8	51
2PLC610	1"	1	10.8	51
2PS700D	1½"	1	5.4	51
2PS701D	1½"	4	18.6	40
2PS702D	1½"	5	24.0	40

WBN CABLE PULLBYS
DAMAGE TYPES

□ CONDUCTOR EXPOSED

O INSULATION DAMAGED BUT CONDUCTOR NOT EXPOSED

X SHIELD OR ASSEMBLY WRAP DAMAGED BUT INSULATION NOT DAMAGED

▪ JACKET COMPLETELY PENETRATED BUT NO DAMAGE TO ASSEMBLY WRAP, SHIELD, OR INSULATION

△ JACKET CUT, SCRAPE, SCUFF, OR NICK THAT DOES NOT COMPLETELY PENETRATE (GOUGE)

✡ INDENTATION

• BEND OR KINK

$ SOFT SPOT

BULGE

⊗ DAMAGE TO OUTER JACKET (CUT, PUNCTURE, ETC.) CONDITION OF SHIELD, DRAIN, AND CONDUCTORS UNKNOWN

JNP/7-15-89.
J 7/15/89

Page 89

MR A-631256

WORK INSTRUCTIONS.

STEP NO.	HOLD POINT	DESCRIPTION		
K 27.		MEASURE AND RECORD BELOW THE DISTANCE BETWEEN THE 2-JB-292-1636-D END OF THE CABLE AND EACH IDENTIFIED DAMAGED AREA. ALSO RECORD THE GENERAL TYPE OF DAMAGE i.e PUNCTURE, TEAR, ABRASION, etc.		
		NOTE: MEASUREMENTS SHOULD BE IN FEET AND INCHES ± 1 INCH.		
		SEQUENCE #	DISTANCE FROM 2-JB-292-1636-D	TYPE DAMAGE
6474	=	2PS284D → 1	28'-0"	BUMP IN JACKET
6474	□	2PS284-D-B	51'-4"	JACKET SHAVED / BROKEN OPEN EXPOSING CONDUCTORS.
		~~2PS284-D-2~~	WWA 7/19/89 RSD 7/19/89	INSULATION SHAVED OFF CONDUCTORS AND CONDUCTORS BENT / TWISTED
702	△	2PS284-D-2	188'-5"	CUT IN JACKET
		FIRST PARTY VERIFICATION William W Blaking DATE 7/19/89		
		SECOND PARTY VERIFICATION Robert S Davis DATE 7/19/89		

25

Phillip L Hartsock 7-20-89
FIRST PARTY VERIFICATION / DATE
Michael W. Ruiz 7-20-89
SECOND PARTY VERIFICATION / DATE

JNP/7-15-89
JNP 7/15/89

Page 9 of

#24

WORK INSTRUCTIONS:

MR A-631256

STEP NO. (INT.)	HOLD POINT	DESCRIPTION		
		SEQUENCE #	DISTANCE FROM 2-JB-292-1636-D	TYPE DAMAGE
X	6474	2PS283D-A 2PS283D-1	30'-9"	TEAR IN JACKET TEAR PENETRATES JACKET
Δ	701	2PS283D-2	173'-5"	SMALL CUT IN JACKET