

# Memo

Date: October 31, 2017

To: IRR Team

From: Toshi Tanabe, NSLS-II Insertion Devices Group Leader



Subject: Modifications to the U42 Undulator at Cell 7 for the SST Beamline

Prior to installation at NSLS-II, modifications were made to the mechanical and controls systems for the U42 Undulator, installed at ring cell 7. These modifications are outlined below:

## *Mechanical Modifications*

1. A transport fixture was designed and manufactured to transport the U42 from the building 832 Hi-Bay to the storage building and then through the storage ring tunnel. It was designed as a frame with a set of forklift tubes that double as support outriggers that can accommodate air casters below it. The frame is slid between the bottom of the undulator frame and the floating base plate and clamped in place by the three nuts located on the base height adjusting studs. Once attached, it was very easy to switch between forklift and air caster transport
2. It was decided that the rotary encoders mounted on the axis of the ball screw shafts were not accurate enough for our purposes. Also, these were only relative and not absolute. So, a new encoder system was designed based on the Danfysik design used on the IXS IVU, but with a different stroke.
3. Due to a lack of ESRF drawings, tooling needed to be designed to manually locate the encoder support plates accurately to the carriage weldments, and then pin and bolt them in-situ instead of beforehand.
4. The old 5-phase gap drive stepping motors and gearboxes needed to be retrofitted and replaced with the newer 3-phase gap drive stepping motors and updated gearboxes. This also required the purchase of 2 new gearboxes and the machining of two new shaft adapters and corresponding adapting hubs.
5. A new control rack was designed and built for the U42 control system.
6. A new motor driver amplifier, a standard NSLS-II Delta Tau controller was installed in the control rack along with power supplies, cabling and other corresponding components.
7. A set of four Magic Finger Holders containing provision for up to 2 rows of pill magnets was installed on each end of both the upper and lower girders to adjust the field integral.
8. A new set of correction coils was designed, along with a set of support stands based on Bosch 90 x 90 extrusion and steel bases that were adjustable in both X, Y, Z, and tilt.

9. A new kill and limit switch system with an integral fine-adjustable trip dog mounting arrangement was designed and manufactured based on the 5-Plunger Version of the Euchner switch that uses the 5-groove trip dog rail.
10. Lead shielding needed to be integrated into the encoder system in order to protect the encoder read heads from radiation.
11. Software was written for the gap drives, motor brakes, encoder feedback, limits, kills, etc.
12. A removable set of polycarbonate guards was designed and manufactured to protect anyone from getting too close to the magnet array.
13. The existing base plate which was not designed for grout needed to be modified in order to be grouted into the straight section.
14. A set of open gap limit switches was installed to trigger the EPS system.
15. A set of upstream and downstream hard stops for both gap open and gap closed was designed and mounted to the welded undulator frame to prevent over travel of gap motion in both open and closed directions.

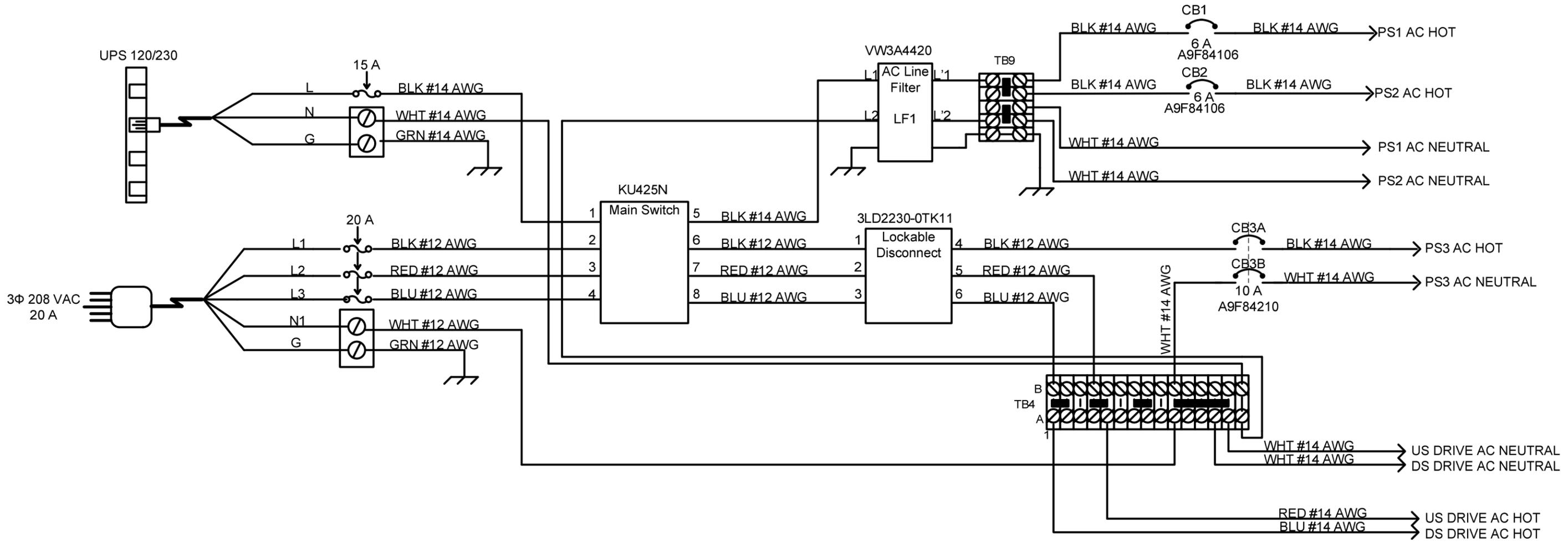
### ***Controls Modifications***

1. Essentially everything related to controls is new on the U42 device. The stepping motors and brakes were replaced with new 3-phase stepping motors with integrated brakes and brake controls in the stepping motor driver. The device had no limit switches, kill switches, e-stops, or encoders, so those were added.
2. There was no control system for the device, so a new control system was designed and built. The design was based on the control system for the Kyma EPU's on the FSM beamlines.
  - a. This control system uses a Delta Tau Brick stepping motor controller and Reer Safety PLC to read the encoders and react to limit, kill, and e-stop switch inputs. The controller, safety PLC, power supplies, circuit breakers, and solid-state relays used for the control system were all new.
3. The software running on the Delta Tau Brick controller and the Reer Safety PLC were adapted from the software from COSYlab used to run the Kyma EPU49. This software was simplified and reconfigured so that it was more compartmentalized, easier to understand, and easier to maintain.

cc:

A. Ackerman  
D. Bergman  
A. Broadbent  
P. Cappadoro  
E. Cheswick  
D. Fischer  
G. Ganetis  
J. Kirkland  
B. Kosciuk  
H. Robinson  
K. Rubino

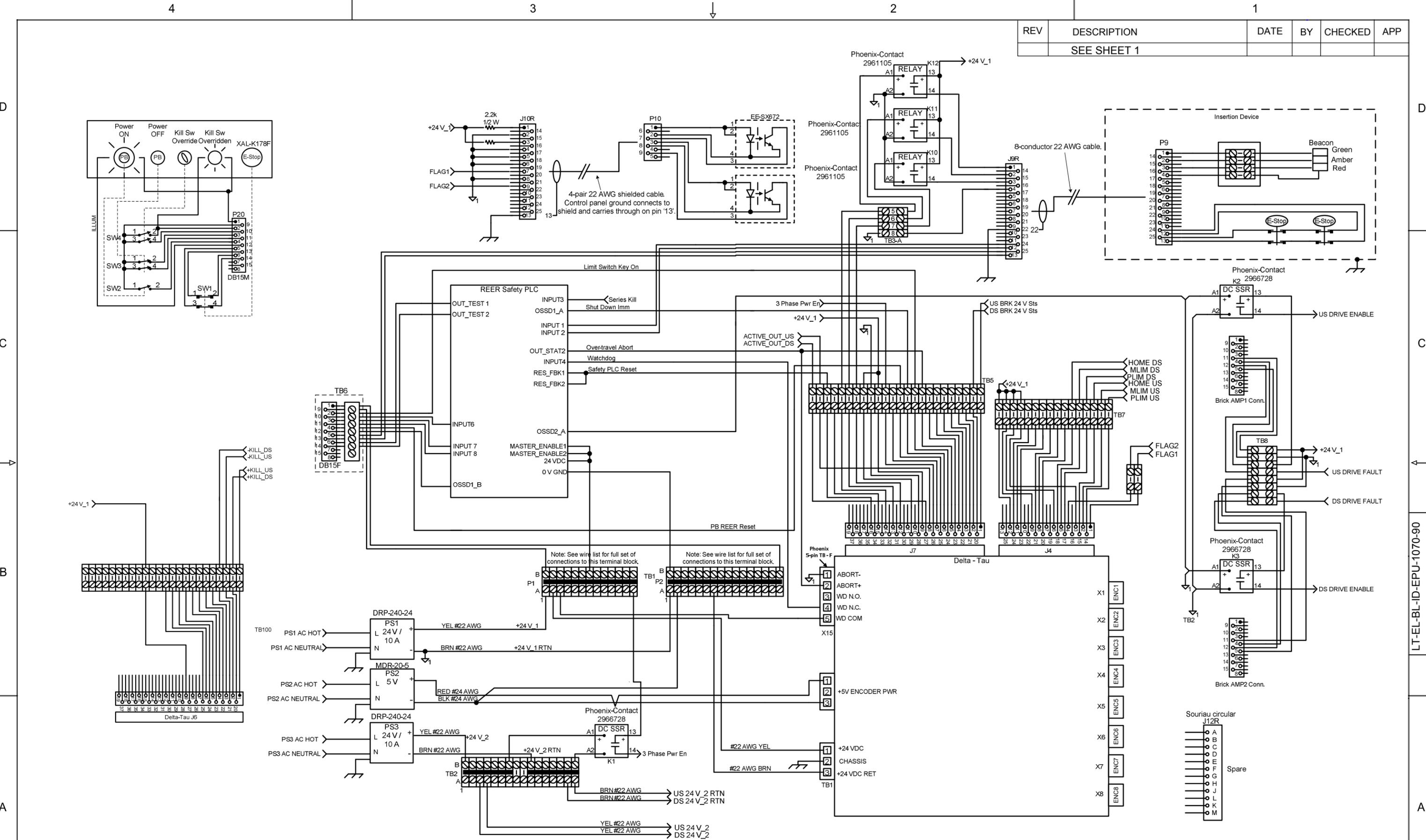
REV	DESCRIPTION	DATE	BY	CHECKED	APP
A	INITIAL RELEASE	05-06-17	DB	MP	DB



		BROOKHAVEN NATIONAL LABORATORY BROOKHAVEN SCIENCE ASSOCIATES UPTON, NEW YORK 11973 <i>Exploring Life's Mysteries,          Protecting its Future</i>			
UNLESS OTHERWISE SPECIFIED INTEGER TOLERANCES $\pm .06$ DECIMAL TOLERANCES .X $\pm .030$ .XX $\pm .015$ .XXX $\pm .010$ ANGULAR TOLERANCE $\pm 0.5^\circ$ UNSPECIFIED RADII .02 MAX 125  BREAK SHARP CORNERS AND EDGES FINISH MAX .03 MIN .005		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSIONS IN [".**"] ARE MILLIMETERS EQUIV. FOR REF. ONLY	ESH&Q RISK LEVEL A-2	<h2 style="text-align: center;">WIRING DIAGRAM</h2> <h3 style="text-align: center;">NSLS-II 7-ID (SST1) U42 UNDULATOR          GAP MOTION CONTROL</h3>	
INTERPRET DRAWING AS PER ANSI Y14.5 OR Y32.2		DATE 05-26-17	OUTSTANDING ECN'S		
DRWN BY	D.BERGMAN	05-26-17		LT-EL-SR-PS DRAWING DIRECTORY <b>LT-EL-BL-ID-UND-1070-90</b> DRAWING NUMBER <b>A</b> REV	
CHK BY	M.PFEFFER	05-26-17			
ENG APP	D.BERGMAN	05-26-17			
SUPV APP	G.GANETIS	06-29-17			
QA APP	E. CHESWICK	06-26-17			
ESH APP	B. LEE	06-27-17		COMPUTER REPRODUCIBLE SCALE: N/A SHEET 1 OF 4	

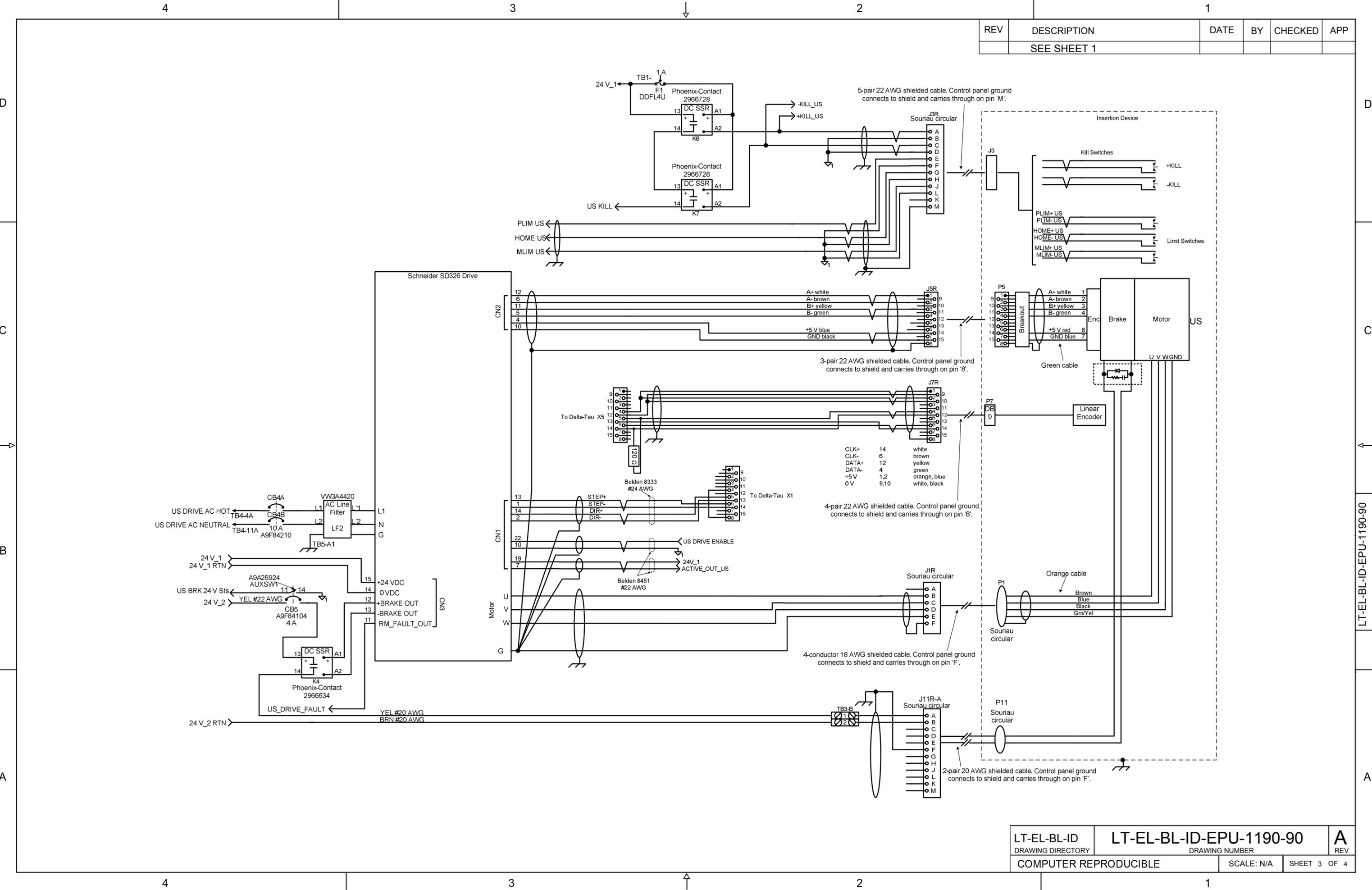
LT-EL-BL-ID-EPU-1070-90

REV	DESCRIPTION	DATE	BY	CHECKED	APP
	SEE SHEET 1				



LT-EL-BL-ID	LT-EL-BL-ID-EPU-1070-90	A
DRAWING DIRECTORY	DRAWING NUMBER	REV
COMPUTER REPRODUCIBLE	SCALE: N/A	SHEET 2 OF 4

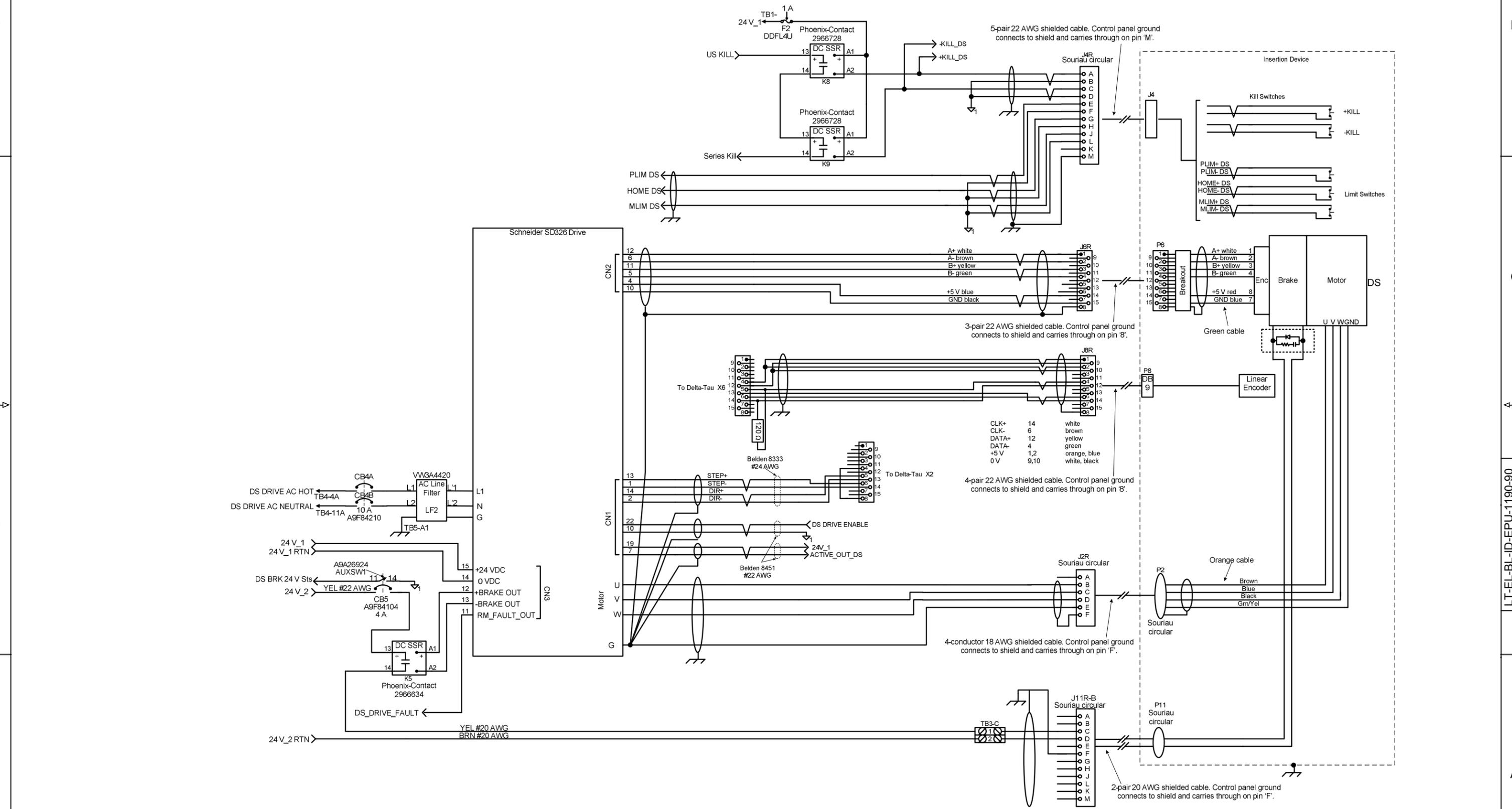
REV	DESCRIPTION	DATE	BY	CHECKED	APP
	SEE SHEET 1				



LT-EL-BL-ID	LT-EL-BL-ID-EPU-1190-90	A
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COMPUTER REPRODUCIBLE	SCALE: N/A	SHEET 3 OF 4

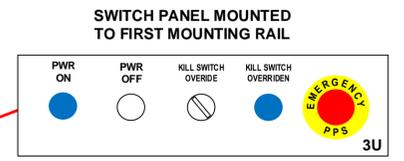
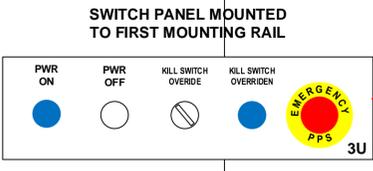
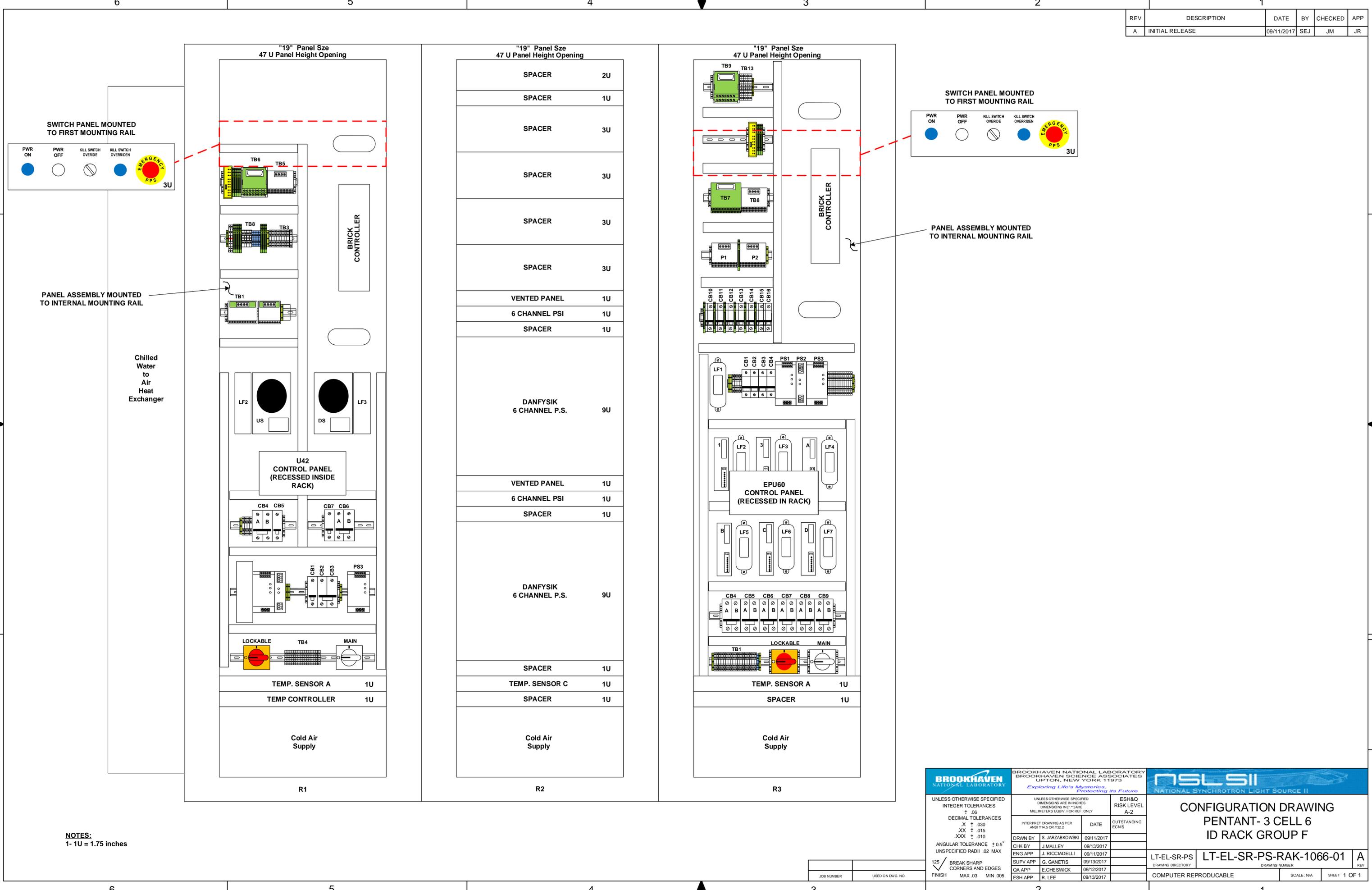
LT-EL-BL-ID-EPU-1190-90

REV	DESCRIPTION	DATE	BY	CHECKED	APP
	SEE SHEET 1				



LT-EL-BL-ID	LT-EL-BL-ID-EPU-1190-90	A
DRAWING DIRECTORY	DRAWING NUMBER	REV
COMPUTER REPRODUCIBLE	SCALE: N/A	SHEET 4 OF 4

REV	DESCRIPTION	DATE	BY	CHECKED	APP
A	INITIAL RELEASE	09/11/2017	SEJ	JM	JR



PANEL ASSEMBLY MOUNTED TO INTERNAL MOUNTING RAIL

PANEL ASSEMBLY MOUNTED TO INTERNAL MOUNTING RAIL

Chilled Water to Air Heat Exchanger

**NOTES:**  
1- 1U = 1.75 inches

UNLESS OTHERWISE SPECIFIED INTEGER TOLERANCES ± .06 DECIMAL TOLERANCES .X ± .030 .XX ± .015 .XXX ± .010 ANGULAR TOLERANCE ± 0.5° UNSPECIFIED RADII .02 MAX 125 ✓ BREAK SHARP CORNERS AND EDGES FINISH MAX .03 MIN .005		BROOKHAVEN NATIONAL LABORATORY BROOKHAVEN SCIENCE ASSOCIATES UPTON, NEW YORK 11973 <i>Exploring Life's Mysteries, Protecting its Future</i> UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSIONS IN " ARE MILLIMETERS EQUIV. FOR REF. ONLY INTERPRET DRAWING AS PER ANSI Y14.5 OR Y32.2 DATE DRWN BY S. JARZABKOWSKI 09/11/2017 CHK BY J. MALLEY 09/13/2017 ENG APP J. RICCIADELLI 09/11/2017 SUPV APP G. GANETIS 09/13/2017 QA APP E. CHESWICK 09/12/2017 ESH APP R. LEE 09/13/2017 ESH&Q RISK LEVEL A-2 OUTSTANDING ECNS	
<b>CONFIGURATION DRAWING PENTANT- 3 CELL 6 ID RACK GROUP F</b>			
LT-EL-SR-PS DRAWING DIRECTORY		<b>LT-EL-SR-PS-RAK-1066-01</b> DRAWING NUMBER	
COMPUTER REPRODUCIBLE		SCALE: N/A SHEET 1 OF 1	

JOB NUMBER	USED ON DWG. NO.
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LT-EL-SR-PS-RAK-1066-01

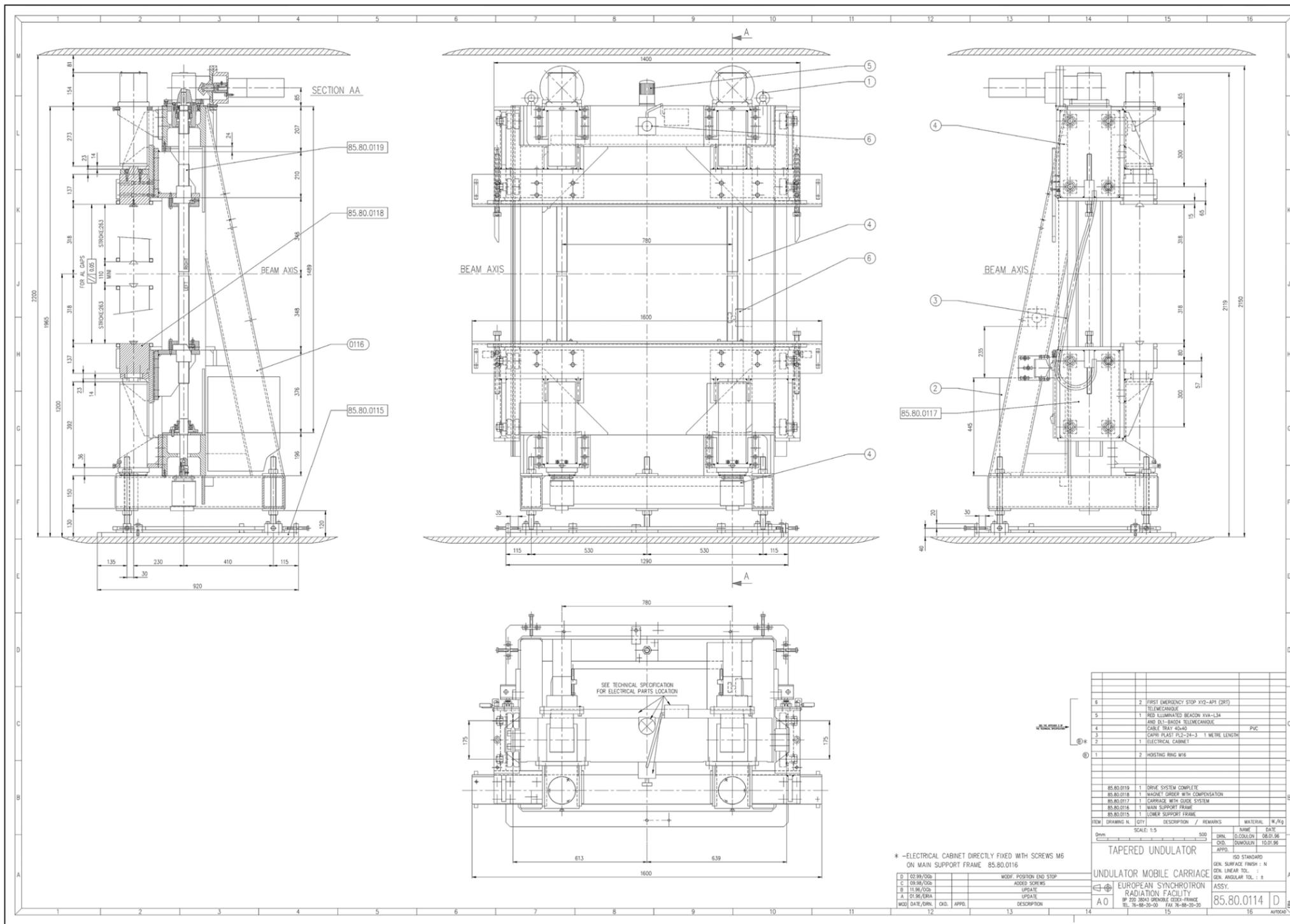
A

B

C

D

REVISION HISTORY					
REV	DESCRIPTION	DATE	DESIGNER	CHECKED BY	ENGINEER
A	RELEASE PER ECO-005277	9/17	FAUSSETTE	CA/ML	CAPPADORO



**VENDOR ITEM CONTROL DRAWING**

IDENTIFICATION OF THE SUGGESTED SOURCE(S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEMS.

SUGGESTED SOURCE OF SUPPLY		
BNL CONTROL NO.	VENDOR PART NO.	NAME & ADDRESS
SR-ID-SST-U42-1000	85.80.0114	EUROPEAN SYNCHOTRON RADIATION FACILITY BP 220 38043 GRENOBLE CEDEX FRANCE

\* -ELECTRICAL CABINET DIRECTLY FIXED WITH SCREWS M6 ON MAIN SUPPORT FRAME 85.80.0116

ITEM	QTY	DESCRIPTION	REMARKS	MATERIAL	Wt./Pcs
6	2	FIRST EMERGENCY STOP XY2-AP1 (2RT) TELEMECANIQUE			
5	1	RED ILLUMINATED BEACON VIA-L34 AND D1-BEACON TELEMECANIQUE			
4	1	CABLE TRAY 40x60 CAPRI PLAST P13-24-3 1 METRE LENGTH		PVC	
3	1	ELECTRICAL CABINET			
2	1	HOSTING RING M16			

DATE	DESCRIPTION	BY	APPD.
02/99/000	MODIF. POSITION END STOP		
02/99/000	ADDED SCREWS		
11/96/000	UPDATE		
01/96/ERRA	UPDATE		

TAPERED UNDULATOR  
UNDULATOR MOBILE CARRIAGE  
EUROPEAN SYNCHOTRON RADIATION FACILITY  
BP 220 38043 GRENOBLE CEDEX-FRANCE  
TEL. 78-88-25-00 FAX 78-88-25-28  
85.80.0114 D

UNLESS OTHERWISE SPECIFIED	
ALL DIMENSIONS ARE IN MILLIMETERS DIMENSIONS IN BRACKETS ARE (WHERE PRESENT) ARE NICHES AND ARE FOR REFERENCE ONLY	
INTERPRET DRAWING AS PER ABME Y143-1984 OR Y122-1975	
DIMENSIONAL TOLERANCES	ANGULAR TOLERANCE
X ± 1.500 ± 5°	
.X ± 0.750	
.XX ± 0.400	FINISH 3.2
.XXX ± 0.120	
BEAM EDGES & SHARP CORNERS 0.120 MIN. TO 0.750 MAX	
THIRD ANGLE PROJECTION	SCALE: SEE DWG VIEW

BROOKHAVEN NATIONAL LABORATORY		NATIONAL SYNCHROTRON LIGHT SOURCE II	
DRAWN BY	FAUSSETTE	DATE	9/20/2017
CHECKED BY	CA/ML	DATE	9/17
VACUUM APPROVAL			
ENGINEER APPROVAL	CAPPADORO	DATE	9/17
SUPERVISOR APPROVAL	TANABE	DATE	9/17
ESH APPROVAL	ACKERMAN	DATE	9/17
QA APPROVAL	CHESWICK	DATE	9/17
PROJECT: SR-ID-SST-U42-1001		WBS# 7.02.05.02.02	
SHEET SIZE		DRAWING/PART NUMBER	
ESH&Q RISK LEVEL A3		SR-ID-SST-U42-1000	
SHEET 1 OF 1		REVISION A	

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