1580 Sawgrass Corporate Parkway, Suite 400
Sunrise, FL 33323

T: 954.200.7611

May 14, 2024

Ms. Wilhelmina Montero, P.E.
Senior Project Manager
Department of Public Utilities - ECSD
City of Hollywood
1621 N. 14th Avenue
Hollywood, Florida 33022

158421

Subject: Deep Injection Wells No. 3 and No. 4 Pump Station Project
Change Order No. 5 – Time Extension

Dear Ms. Montero:

Please receive this letter as Brown and Caldwell's recommendation to approve Change Order No. 5. This change order facilitates an extension to Cardinal Contractors' contract time period. There is no additional cost associated with this matter.

Attached you will find the contractor's letter dated May 3, 2024 requesting a time extension due to delayed electrical equipment deliveries that are beyond their control. Unfortunately, such delays have become common in the construction industry and the delays are negatively affecting the schedules of many other projects.

Though Cardinal references other days and time periods, we have marked up the letter to clarify the newly proposed dates and time period pertinent to this change order.

Also attached is a brief narrative summarizing the time extension and explaining how the recommended new completion dates were determined.

Original Substantial Completion Date	November 1, 2024
Time Extension	370 days
New Substantial Completion Date	November 6, 2025

Please let me know if you have any questions.

Very truly yours,

Brown and Caldwell

Mark Harber, Construction Manager
Sunrise, Florida

CHANGE ORDER NO. 5 – TIME EXTENSION

NARRATIVE

This time extension covers all changes and project impacts to the construction schedule during the time period of from the Notice to Proceed of May 16, 2022 through March 31, 2024. For the duration of this time period, the General Contractor has identified several different types of project schedule impacts outside of their control which are detailed below.

List of Impacts to project schedule through March 31, 2024

Impact 1	Emergency Work	25		
Impact 2	FPL Vault Redesign	90		
Impact 3	Weather NTP - 12/31/2023	58		64 days of weather less 6 days per contract.
	Concurrency Adjustment	-23		Weather impact concurrent with vault redesign.
Impact 4	Weather 1/1 - 3/31/2024	5		
	Summary of All Impacts			
	Total Days of Impact	155		Total Schedule Impact for Items Listed

Each issue listed above has impacted progress on the schedule. However, it has been determined that a concurrent impact to the schedule exists that will cause the project time to extend far further than the 155 calendar days that stem from Impacts 1 – 4.

The contractor has been informed by its supplier to expect delays to the delivery of the medium voltage switchgear, medium voltage transformers and ancillary equipment. The new expected delivery date is March 31, 2025 for the following specific electrical gear:

- Medium Voltage Primary Unit Substation Transformer MV-UST-1A
- Medium Voltage Primary Unit Substation Transformer MV-UST-1B
- Medium Voltage Generator Switchgear 1A/1B
- Medium Voltage Generator Switchgear 2A/2B
- MV-MTS-1 (for existing North Electrical Services Center)
- MV-MTS-2 (for existing North Electrical Services Center)
- Remote Operator Panels for listed gear.

Total Impact of Expected Late Deliveries 370 Days

The total impact of 370 days is determined as follows:

November 1, 2024 – Original Contract Substantial Completion Date

March 31, 2025 – Expected Late Delivery of Electrical Gear

+ 180 days of gear installation + 20 days of startup +20 days of commissioning

November 6, 2025 – New Substantial Completion Date

180 days of installation is necessary due to many wiring connections to be made to the switchgear and complex programming that must be done to bring the generator system on-line.

May 3, 2024

Mr. Mark Harber, Project Manager
Brown and Caldwell | Hollywood SRWTP
MHarber@Brwncald.com

Re: Hollywood Deep Injection Wells No. 3 and No. 4 Pump Station
Cardinal Job #: 85030, City Project #: 19-9119A
Phase 2 - Contract Time Extension – Arc Flash Switchgear and Transformers Delivery Delays

Mr. Harber,

As a follow-up to our monthly meeting below is the manufacturer delivery delays for the Generators Arc Flash Switchgear and the Wet Transformers. These delays are due to market conditions, a shortage of key components and product demand backlog.

Item	Manufacture Lead Time (After Approval)	Original Delivery	Revised Delivery	Calendar Days Impact
Arc Flash Switchgear MV-GSWGR-1A, 2A MV-GSWGR-2A, 2B	40 Weeks	June 25, 2024	Mar 31, 2025	279
Transformers MV-UST-1A, 1B	80 Weeks	Aug 7, 2024	Mar 31, 2025	204

In addition to the above, there are post-installation tasks that follow the delivery of the Switchgear and Transformers, as well as start-up, testing and commissioning.

Our Project Schedule has an Electrical Installation task of 180 Days, Start-Up 20 Days and Commissioning 20 Days. The cumulative total of the manufacturer delivery delays is 499 Days.

Currently, we are requesting a Contract Time Extension of 344 Days for the manufacturer delivery delays. The 344 Days considers the concurrency of the previously submitted 155 Days for Weather, FPL Vault and the Emergency Work through 2023.

The above request is based on the best-known information. Should further manufacturer delays occur, Cardinal Contractors (Primoris) reserves the right to re-address this matter.

Please review and incorporate into the pending Change Order.

If you have any questions, feel free to give me a call.

Engineer's note: The Revised Delivery date of March 31, 2025 is the basis of Change Order No. 5 and the revised project schedule.

March 31, 2025 + 180 days of equipment installation + 20 days of startup + 20 days if commissioning.

Sincerely,

Cardinal Contractors / Primoris Inc.

Joe H. Brown Jr.
Sr. Project Manager

Attachment(s)

CC: Claudette Pearson (Primoris)
Travis Johnson (Primoris)
Michael Brandao (Primoris)

Joe Brown

From: Alonso Chigne Valerga
Sent: Thursday, March 14, 2024 2:19 PM
To: Claudette Pearson
Cc: Joe Brown
Subject: Updated Shipping Dates - Loveland & Pantropic

Claudette,

Please see below as discussed.

Line item	Vendor	MTO Description	Promise shipping date	Ship date actual	Receipt date
21	Loveland	LV-UST-1A Primary Switch	29-Feb-24		29-Feb-24
21A	Loveland	LV-UST-1B Primary Switch	29-Feb-24		29-Feb-24
21B	Loveland	LV-UST-1A Transformer	29-Jun-23		31-Oct-23
21C	Loveland	LV-UST-1B Transformer	29-Jun-23		31-Oct-23
21D	Loveland	LV-UST-2A Primary Switch	26-Apr-24		
21E	Loveland	LV-UST-2B Primary Switch	29-Feb-24		29-Feb-24
21F	Loveland	LV-UST-2A Transformer	29-Jun-23		31-Oct-23
21G	Loveland	LV-UST-2B Transformer	29-Jun-23		31-Oct-23
21H	Loveland	LV-SWGR-2A/2B	13-May-24		
21I	Loveland	LV-SWGR-1A/1B	19-May-24		
21J	Loveland	MV-UST-1A	31-Mar-25		
21K	Loveland	MV-UST-1B	31-Mar-25		
21L	Loveland	SB-1A/1B	03-May-24		
21M	Loveland	SB-2A/2B	29-Feb-24		29-Feb-24

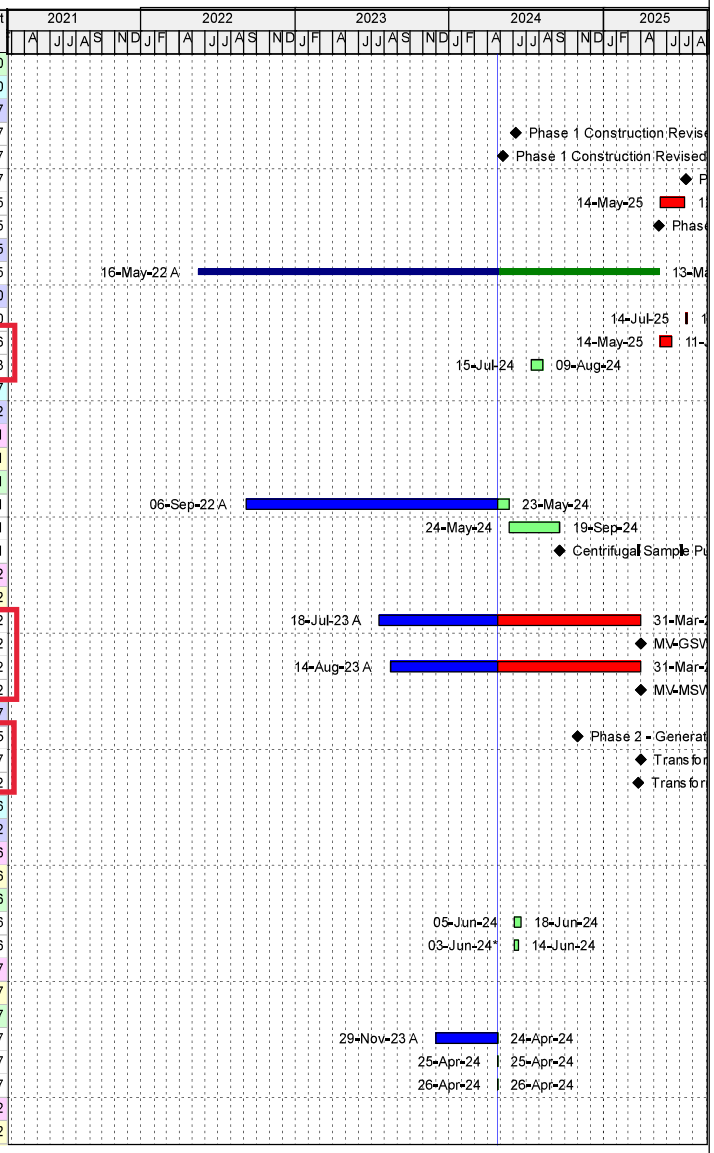
Line item	Vendor	MTO Description	Promise shipping date	Ship date actual
11	Pantropic	MV-GSWGR (IWESC Electrical Room)	31-Mar-25	
11A	Pantropic	MV-MSWGR-1A/1B (IWESC Electrical Room)	31-Mar-25	
11B	Pantropic	Control Panels (IWESC Electrical Room)	31-Mar-25	
11C	Pantropic	DEF Storage Tank (IWESC Electrical Room) (BY OTHERS)	N/A	
11D	Pantropic	Day Tanks (IWESC Electrical Room)	30-Jun-24	
11E	Pantropic	Generator 01 and Generator 02 (IWESC Electrical Room) (Indoor Units)	30-Jun-24	
11F	Pantropic	Automatic Transfer Switches (IWESC Electrical Room)	30-Jun-24	
11G	Pantropic	Station Batteries (IWESC Electrical Room)	31-Mar-25	
11H	Pantropic	MV-SWGR-2A/2B (IWPS2 Electrical Room)	31-Mar-25	
11I	Pantropic	Remote Operator Panels (IWPS2 Electrical Room)	31-Mar-25	
11J	Pantropic	New Generator Set and Enclosure (South Electrical Service Building) (Outdoor Unit)	30-Sep-24	
11K	Pantropic	Modifications to Existing Switchgear (South Electrical Service Building)	30-Jun-24	
11L	Pantropic	Remote Operator Panels (South Electrical Service Building)	31-Mar-25	
11M	Pantropic	MV-MTS-1 (North Electrical Service Building)	31-Mar-25	
11N	Pantropic	MV-MTS-2 (North Electrical Service Building)	31-Mar-25	
11O	Pantropic	Remote Operator Panels (North Electrical Service Building)	31-Mar-25	

Thanks,

Alonso Chigne Valerga
Field Engineer 2 / Materials Manager
Primoris Water & Mechanical
13794 NW 4th St, Suite 200
Sunrise, FL 33325
Cell # (386) 314-7582

85030 - Hollywood Deep Injection Wells 3 and 4 Pump Station - Current

Activity ID	Activity Name	WBS Name	Original Duration	Start	Finish	Total Float
85030 - Hollywood Deep Injection Wells 3 and 4 Pump Station - Current			813	16-May-22 A	18-Jul-25	0
Key Summary			813	16-May-22 A	18-Jul-25	0
Project Milestones			298	06-May-24	14-Jul-25	-107
PH1.1565	Phase 1 Construction Revised - Final Complete	Project Mile	0		05-Jun-24	187
PH1.1450	Phase 1 Construction Revised - Substantial Complete	Project Mile	0		06-May-24	187
PH2.9010	Phase 2 Construction - Final Complete	Project Mile	0		14-Jul-25*	-107
PH2.9000	Phase 2 Construction - Punchlist and Closeout	Project Mile	60	14-May-25	12-Jul-25	-155
PH2.7190	Phase 2 Construction - Substantial Complete	Project Mile	0		13-May-25	-155
Project Duration			1018	16-May-22 A	13-May-25	-155
A10000	Project Duration	Project Dura	1018	16-May-22 A	13-May-25	-155
Key Items			256	15-Jul-24	18-Jul-25	0
A1030	Demobilize	Key Items	5	14-Jul-25	18-Jul-25	0
PH2.7410	Phase 2 - Commissioning	Key Items	20	14-May-25	11-Jun-25	-86
PH2.8050	Phase 2 - Testing	Key Items	20	15-Jul-24	09-Aug-24	83
Procurement			629	06-Sep-22 A	31-Mar-25	-77
Purchase Orders			911	06-Sep-22 A	31-Mar-25	-112
Equipment			718	06-Sep-22 A	19-Sep-24	81
Pumps			718	06-Sep-22 A	19-Sep-24	81
Centrifigal Sample Pumps			718	06-Sep-22 A	19-Sep-24	81
A9280	Centrifugal Sample Pump PMP-1022 [C&V - Flowserve] - Approve Vendor D	Centrifigal S	30	06-Sep-22 A	23-May-24	81
A9290	Centrifugal Sample Pump PMP-1022 [C&V - Flowserve] - Fabrication	Centrifigal S	119	24-May-24	19-Sep-24	81
A9300	Centrifugal Sample Pump PMP-1022 [C&V - Flowserve] - On Site	Centrifigal S	0		19-Sep-24	81
Electrical Biulding - IWESC			623	18-Jul-23 A	31-Mar-25	-142
Switchgears			623	18-Jul-23 A	31-Mar-25	-142
A9390	MV-GSWGR - [Pantropic] - Fabrication	Switchgears	273	18-Jul-23 A	31-Mar-25	-142
A9400	MV-GSWGR - [Pantropic] - On Site	Switchgears	0		31-Mar-25	-142
A9430	MV-MSWGR 1A/1B - [Pantropic] - Fabrication	Switchgears	204	14-Aug-23 A	31-Mar-25	-142
A9440	MV-MSWGR 1A/1B - [Pantropic] - On Site	Switchgears	0		31-Mar-25	-142
Late Arrival			102	31-Oct-24	31-Mar-25	-107
A10070	Phase 2 - Generators	Late Arrival	0		31-Oct-24*	-5
A10010	Transformer MV-UST-1A (Loveland)	Late Arrival	0		31-Mar-25*	-107
A10020	Transformer MV-UST-1B (Loveland)	Late Arrival	0		25-Mar-25*	-102
Construction			393	25-May-23 A	13-May-25	46
Phase 1 Revised Construction			197	29-Nov-23 A	10-Sep-24	62
Site			12	03-Jun-24	18-Jun-24	66
Yard Pipe			12	03-Jun-24	18-Jun-24	66
WP 350-106 12" PW Section Below Retaining Wall #2			12	03-Jun-24	18-Jun-24	66
PH2.1860	Phase 1 - 12" PW Section Below Retaining Wall #2 - Backfill	WP 350-106	10	05-Jun-24	18-Jun-24	66
PH2.1850	Phase 1 - 12" PW Section Below Retaining Wall #2 - Install Pipe	WP 350-106	10	03-Jun-24*	14-Jun-24	66
Injection Well #4			103	29-Nov-23 A	26-Apr-24	137
Electrical			103	29-Nov-23 A	26-Apr-24	137
IW# 4 Foundation			103	29-Nov-23 A	26-Apr-24	137
A8050	Phase 1 - IW#4 - Install Groundng Grid	IW# 4 Foun	1	29-Nov-23 A	24-Apr-24	137
A8100	Phase 1 - IW#4 - Install Light Fixture	IW# 4 Foun	1	25-Apr-24	25-Apr-24	137
A8110	Phase 1 - IW#4 - Pull Wire And Terminate Light Fixture	IW# 4 Foun	1	26-Apr-24	26-Apr-24	137
Monitoring Well			2	09-Sep-24	10-Sep-24	62
Electrical			2	09-Sep-24	10-Sep-24	62



Start Date: 29-Apr-22 Data Date: 24-Apr-24

Finish Date: 18-Jul-25 Run Date: 24-Apr-24

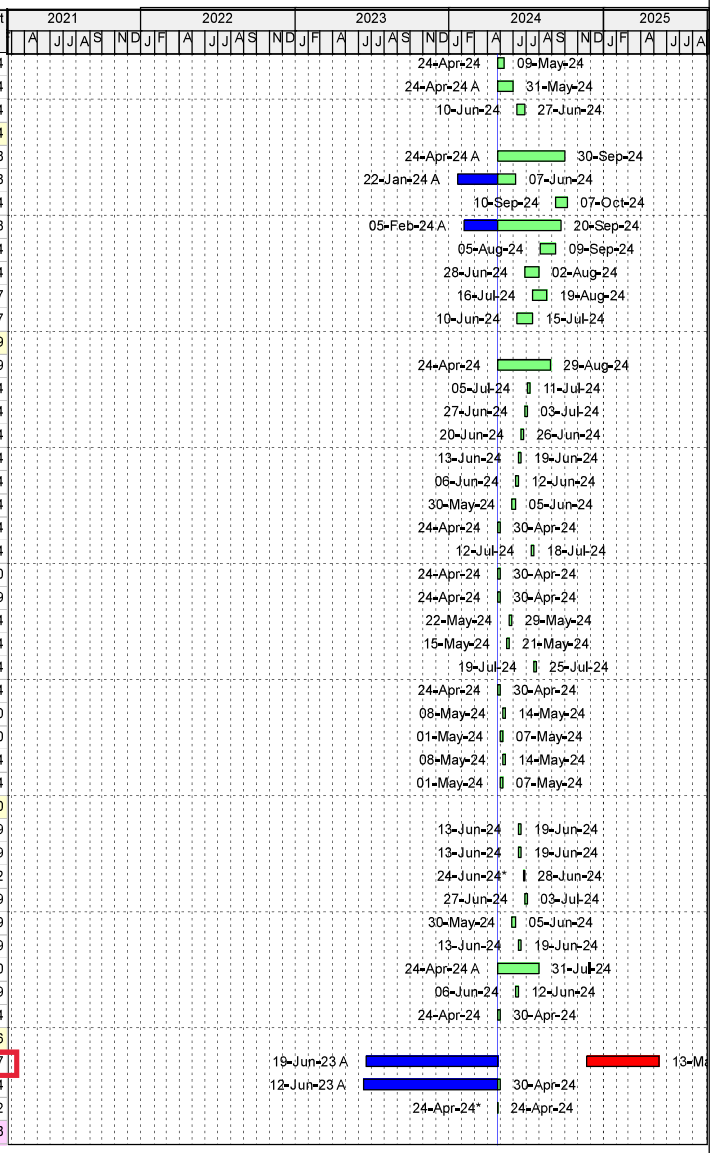
Primoris Services Corporation
Cardinal Contractors

TASK filter: Physical % Complete <100%.

Remaining Level of Effort
Actual Level of Effort
Actual Work
Remaining Work
Critical Remaining Work
Milestone

85030 - Hollywood Deep Injection Wells 3 and 4 Pump Station - Current

Activity ID	Activity Name	WBS Name	Original Duration	Start	Finish	Total Float
PH2.7950	Phase 2 - IWESC FDN - Parapet to Elv 34.00 - [3C]	Civil	12	24-Apr-24	09-May-24	84
PH2.7980	Phase 2 - IWESC FDN - Parapet to Elv 46.33 - [3C]	Civil	12	24-Apr-24 A	31-May-24	84
PH2.7990	Phase 2 - IWESC FDN - Topping @ Generator & Switchgear Room - [3C]	Civil	14	10-Jun-24	27-Jun-24	84
Buildings			133	22-Jan-24 A	07-Oct-24	84
PH2.4510	Phase 2 - IWESC - Install E&I	Buildings	36	24-Apr-24 A	30-Sep-24	48
PH2.3790	Phase 2 - IWESC - Install Masonry Block	Buildings	25	22-Jan-24 A	07-Jun-24	48
PH2.3830	Phase 2 - IWESC - Install MISC and Safety Items	Buildings	20	10-Sep-24	07-Oct-24	84
PH2.4500	Phase 2 - IWESC - Install Piping	Buildings	36	05-Feb-24 A	20-Sep-24	48
PH2.3820	Phase 2 - IWESC - Install Roof	Buildings	25	05-Aug-24	09-Sep-24	84
PH2.3780	Phase 2 - IWESC - Install Structural Steel	Buildings	25	28-Jun-24	02-Aug-24	84
PH2.3810	Phase 2 - IWESC - Install Wall Insulation and Finish System	Buildings	25	16-Jul-24	19-Aug-24	77
PH2.3800	Phase 2 - IWESC - Install Wall Louvers & Windows - [PAC]	Buildings	25	10-Jun-24	15-Jul-24	77
Mechanical			90	24-Apr-24	29-Aug-24	69
PH2.9020	Phase 2 - IWESC - - Set Equipment - [Southern Tank]	Mechanical	90	24-Apr-24	29-Aug-24	69
PH2.4380	Phase 2 - IWESC - CEM-5011-2 - Set Equipment	Mechanical	5	05-Jul-24	11-Jul-24	94
PH2.4350	Phase 2 - IWESC - CEM-5012-2 - Set Equipment	Mechanical	5	27-Jun-24	03-Jul-24	94
PH2.4320	Phase 2 - IWESC - CPR-5011-4 - Set Equipment	Mechanical	5	20-Jun-24	26-Jun-24	94
PH2.4290	Phase 2 - IWESC - CPR-5012-4 - Set Equipment	Mechanical	5	13-Jun-24	19-Jun-24	94
PH2.4260	Phase 2 - IWESC - DDC-5011-2 - Set Equipment	Mechanical	5	06-Jun-24	12-Jun-24	94
PH2.4230	Phase 2 - IWESC - DDC-5012-2 - Set Equipment	Mechanical	5	30-May-24	05-Jun-24	94
PH2.4050	Phase 2 - IWESC - DST-5021 - Set Equipment - (Carl Eric Johnson)	Mechanical	5	24-Apr-24	30-Apr-24	94
PH2.4410	Phase 2 - IWESC - Electrical Switchgear Modules - Set Equipment	Mechanical	5	12-Jul-24	18-Jul-24	94
PH2.3940	Phase 2 - IWESC - FDT-5011-3 - Set Equipment - [Southern Tank]	Mechanical	5	24-Apr-24	30-Apr-24	140
PH2.3910	Phase 2 - IWESC - FDT-5012-3 - Set Equipment - [Southern Tank]	Mechanical	5	24-Apr-24	30-Apr-24	69
PH2.4200	Phase 2 - IWESC - GEN-5011-2 - Set Equipment	Mechanical	5	22-May-24	29-May-24	94
PH2.4170	Phase 2 - IWESC - GEN-5012-2 - Set Equipment	Mechanical	5	15-May-24	21-May-24	94
PH2.4430	Phase 2 - IWESC - Install Fuel Pipe Trench Grating	Mechanical	5	19-Jul-24	25-Jul-24	94
PH2.4440	Phase 2 - IWESC - Install Ladders & Handrails	Mechanical	5	24-Apr-24	30-Apr-24	154
PH2.4010	Phase 2 - IWESC - PMP-5011-3 - Set Equipment - [Southern Tank]	Mechanical	5	08-May-24	14-May-24	140
PH2.3970	Phase 2 - IWESC - PMP-5012-3 - Set Equipment - [Southern Tank]	Mechanical	5	01-May-24	07-May-24	140
PH2.4130	Phase 2 - IWESC - PMP-5021-1 - Set Equipment	Mechanical	5	08-May-24	14-May-24	94
PH2.4090	Phase 2 - IWESC - PMP-5021-2 - Set Equipment	Mechanical	5	01-May-24	07-May-24	94
Yard Pipe			50	24-Apr-24 A	31-Jul-24	90
PH2.5760	Phase 2 - IWESC - 1" DEF - Install - [Southern Tank]	Yard Pipe	5	13-Jun-24	19-Jun-24	119
PH2.5910	Phase 2 - IWESC - 1" EE - ENGINE EXHAUST - Install	Yard Pipe	5	13-Jun-24	19-Jun-24	119
PH2.5820	Phase 2 - IWESC - 1/2" (X2) & 1" (X2) FOR & FOS - Install - [Southern Tanl	Yard Pipe	5	24-Jun-24*	28-Jun-24	112
PH2.5940	Phase 2 - IWESC - 1/2" CA - COMPRESSED AIR - Install	Yard Pipe	5	27-Jun-24	03-Jul-24	109
PH2.5850	Phase 2 - IWESC - 12" EE - ENGINE EXHAUST - Install	Yard Pipe	5	30-May-24	05-Jun-24	119
PH2.5700	Phase 2 - IWESC - 2" DEF - Install	Yard Pipe	5	13-Jun-24	19-Jun-24	119
PH2.5790	Phase 2 - IWESC - 2" VENT (X2) - Install	Yard Pipe	5	24-Apr-24 A	31-Jul-24	90
PH2.5880	Phase 2 - IWESC - 20" EE - ENGINE EXHAUST - Install	Yard Pipe	5	06-Jun-24	12-Jun-24	119
PH2.5730	Phase 2 - IWESC - 3" PVC - Install	Yard Pipe	5	24-Apr-24	30-Apr-24	154
Electrical			218	12-Jun-23 A	13-May-25	46
A8840	Phase 2 - #72C Injection Well Electrical Service Center - Install Electrical an	Electrical	180	19-Jun-23 A	13-May-25	-107
PH2.9170	Phase 2 - Install Duct bank [Loveland] under IWESC	Electrical	60	12-Jun-23 A	30-Apr-24	84
PH2.9240	Phase 2 - Top of Bottom Rebar Mat [Loveland] under IWESC	Electrical	0	24-Apr-24*	24-Apr-24	312
Fuel and Surge Storage Tanks			129	04-Dec-23 A	16-Sep-24	58



Start Date: 29-Apr-22 Data Date: 24-Apr-24

Finish Date: 18-Jul-25 Run Date: 24-Apr-24

Primoris Services Corporation
Cardinal Contractors

TASK filter: Physical % Complete <100%.

Remaining Level of Effort
Milestone
Actual Level of Effort
Actual Work
Remaining Work
Critical Remaining Work

Eaton Corporation
Power Distribution and Control Assemblies Division
221 Heywood Rd
Arden, NC 28704

January 22, 2024

David Loveland
Loveland Electric
1344 South Killian Drive
Lake Park, FL 33403

RE: Transformer Lead Time Challenges Affecting the Hollywood Injection Wells Project

David,

Eaton and our transformer partners have experienced an unprecedented demand for power transformers; one which our industry hasn't ever seen before. This sustained record demand has put a severe strain on our overall capacity and extended lead times throughout the industry, including the MV-UST substation style transformers for the Hollywood Injection Wells project. We are diligently working to keep up with our current backlog and will we continue to ship as many transformers as possible.

We appreciate your patience and understanding during these challenging times. If you have any questions or concerns, please do not hesitate to reach out.

Best Regards,

Brian McKinstry
Product Line Manager – IPA/UST
221 Heywood Rd
Arden, NC 28704
BrianaMcKinstry@Eaton.com

Jan 22, 2024

NEMA Applauds Bipartisan Approach in Senate on Distribution Transformer Supply

Share

A bipartisan group of Senators introduced legislation which would stabilize the supply chain and ensure long-term energy efficiency for the production of distribution transformers, following recommendations from the **National Electrical Manufacturers Association** (NEMA). The *Distribution Transformer Efficiency & Supply Chain Reliability Act*, led by Senators Sherrod Brown (D-OH) and Ted Cruz (R-TX), signals a desire from both parties to secure this critical grid component. NEMA was joined by utility trades and domestic steel producers in endorsing the legislation. The bill is in response to a Department of Energy (DOE) rulemaking which will disrupt this critical and already strained supply chain by requiring manufacturers to shift from using grain oriented electrical steel (GOES) to amorphous steel.

"We appreciate Senators Brown and Cruz responding to the electroindustry's call to prioritize and strengthen our distribution transformer supply chains," said Debra Phillips, President and CEO, NEMA. "Distribution transformers are essential to delivering electricity to consumers everywhere

chains," said Debra Phillips, President and CEO, NEMA. "Distribution transformers are essential to delivering electricity to consumers everywhere and we're currently staring at backlogs of two years or more. This bipartisan group of senators understands the record high demand and ongoing supply chain challenges facing manufacturers and are responding by providing legislative direction and much-needed regulatory certainty."

Currently, more than 95% of distribution transformers are made with GOES. Furthermore, there is only a single domestic producer of amorphous steel, and it cannot scale production to meet current or future demand. DOE's proposed rule, set to take effect by June, would further exacerbate the two-plus year lead time to produce distribution transformers, and create bottlenecks in planned grid resiliency, residential construction and e-mobility projects across the country.

Bipartisan cooperation on the distribution transformer shortage has been a hallmark of NEMA's advocacy efforts. The *Distribution Transformer Efficiency & Supply Chain Reliability Act* builds upon another bipartisan Senate endeavor last June. In a letter penned by Senator Bill Hagerty (R-TN) to DOE Secretary Jennifer Granholm and cosigned by 13 Democrats and 33 Republicans, the upper chamber then urged the agency to refrain from promulgating a final rule which would significantly disrupt supply chains by requiring manufacturers to shift to amorphous steel. This bill would limit DOE's ability to establish efficiency standards for distribution transformers above a plane known as trial standard level (TSL) 2. Products made to specifications higher than TSL 2 increasingly require the sole use of amorphous steel to achieve efficiency gains, whereas TSL 2 levels can be achieved with GOES and amorphous steel. DOE already requires these critical grid components to be highly efficient; currently, such products are made to be no less than 97.7% efficient.

NEMA | www.nema.org

OPINION

Supply shortages and an inflexible market give rise to high power transformer lead times

Transformers are a key component in large-scale renewables projects. However, high lead times and rising manufacturing costs are at risk of causing expensive project delays and preventing power plants from being brought online

22 November 2023

3 minute read

Kevin Jacobs
Director, Supply Chain Consulting

Sagar Chopra
Senior Research Analyst, Solar

Aaron Barr
Global Head, Onshore Wind Energy Research

Benjamin Boucher
Senior Analyst

Our recent report, *'Supply shortage and high lead times: market dynamics and supply chain update'*, explores transformer market dynamics and the factors driving supply shortages. Drawing on proprietary data, insights from research analysts, and deep industry links, we look to understand the transformer sector in greater detail, revealing the reasons behind the increase in lead times, and the rise in component costs.

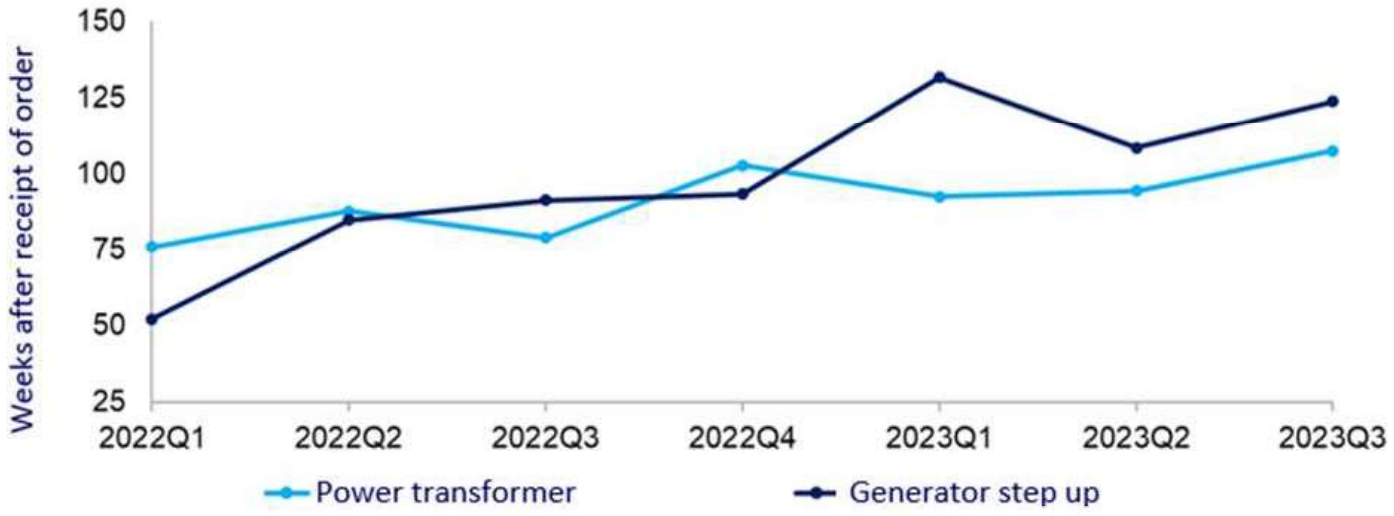
Fill out the form on the top right to download an extract from the full report, or read on for an introduction to the challenges and opportunities across the sector.

Transformer replacement programmes underway at power plants

Transformer lead times have been increasing for the last 2 years - from 115 weeks in 2021, to 130 weeks on average in 2023.

Large transformers, both substation power, and generator step-up (GSU) transformers, have lead times ranging from 80 to 210 weeks, and some manufacturers have already announced plans to expand capacity to meet growing demand.

Power transformer and GSU lead times benchmark: trends over time



Source: Wood Mackenzie

As the global installed base of power transformers continues to age, active replacements are underway at most utilities. In the US, a multi-decade replacement programme is underway as installed transformers surpass their 35 to 40-year design life.

In addition to the supply chain imbalance brought about by the pandemic, transformer lead times have also increased because components require custom specifications that can only be provided by specialist manufacturers.

Manufacturers risk financial instability

Given that it can take decades for transformer manufacturers to break even, many are reluctant to make the investments required to expand production. The same manufacturers that acquired the technology and financial capital in the 1980s, are enjoying full production slots and higher margins because of increased global demand. In turn, this limits their motivation to expand and risk financial instability.

Likewise, major original equipment manufacturers (OEMs) continue to cite material, equipment, and skilled labor constraints as driving factors for supply constraints and consequent increased lead times.

In the US, only around 20% of transformer demand can be met by domestic supply. Despite President Biden signing executive orders In June 2022 to help domestic manufacturers increase their production, funding has yet to be specified in any subsequent bills.

Raw material costs doubled

Transformer prices have risen 60% to 70% on average since January 2020. Commodity prices for raw materials such as Grain Oriented Electrical Steel (GOES) have doubled since January 2020, and copper prices have increased approximately 50% over the same time frame.

During the pandemic, manufacturers expected a drop in demand for transformers, and production for these commodities slowed down. As a result, manufacturers are now struggling to ramp up production levels to meet global demand.

GOES prices have surged by more than 125% since January 2020 due to a large market deficit and key manufacturers curtailing production. This has resulted in GSU transformers seeing a 4% to 15% increase in exposure to GOES over the same period.

GOES prices eased considerably in 2023, falling 23% between January and August. However, prices reversed in September, increasing by 24% month-over-month amid better-than-expected macroeconomic indicators in China. Overall, GOES and copper prices eased by 4% and 8% respectively in 2023.

Potential delays to global renewables projects

As utility companies and project developers face transformer shortages, manufacturing players like Virginia Transformer Corporation and WEG have opened new manufacturing plants to increase their production capacity. Likewise, Sunbelt Solomon has made an investment to establish facilities that support the repair and recycling of transformers.

However, based on conversations with developers and suppliers, we predict that as much as 25% of global renewable projects could be at risk of project delays due to high transformer lead times.

The global demand for standalone photovoltaic (PV), wind and grid scale storage are all expected to grow, which will continue to put pressure on lead times. Unless adequate project planning is put in place to account for supply shortages, many projects could end up being delayed.

Learn more

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U.S. renewable, grid battery projects battle transformer shortage

By **Nicole Jao**

November 15, 2023 12:05 PM EST · Updated 3 months ago

Wind turbines operate at sunrise in the Permian Basin oil and natural gas production area in Big Spring, Texas, U.S., February 12, 2019. REUTERS/Nick Oxford/File Photo

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NEW YORK, Nov 15 (Reuters) - U.S. developers building renewable energy projects and power storage for grids are scrambling to procure critical components, leading to rising costs and project delays.

Supply chain problems have tightened supply of high-voltage transformers necessary to connect wind and solar farms and batteries to the grid, projects that are key to the energy transition.

The long lead-time for delivery of the transformers, which can be the size of a large truck and need to be custom built, has forced some project developers to order equipment before commercial agreements to sell power from the projects are in place, said Vanessa Witte, senior energy storage analyst at Wood Mackenzie.

That and the higher prices they are paying for the equipment means developers are having to take a big bet on getting all the deals and approvals they need to make a project viable, she added.

"It's incredibly risky," she said.

The delivery time for transformers and other associated equipment has grown from 50 weeks a year ago to 150 weeks now, said Ben Pratt, CEO of Nova Clean Energy, a utility-scale project developer based in Chicago.

"We just have to be open and honest with the off-takers about the impact of delays as we move along," Pratt said, referring to buyers of power from renewable projects.

"We realistically can't hit the original commercial operation date we've been discussing."

Some large developers stockpiled transformers and associated equipment before measures to accelerate the deployment of renewable energy in the government's Inflation Reduction Act (IRA) triggered another spike in demand.

"It was a situation that was easily predictable... but the IRA accelerated something that was already in process," said Reagan Farr, CEO of Silicon Ranch, a solar farm developer.

Silicon Ranch spent over $100 million stockpiling transformers and switchgears, Farr said. Developers that did not pre-order equipment are paying a lot more for large transformers and have a lead time for delivery of at least three years, he said.

The IRA, signed into law in August 2022, provides billions in green energy tax credits to accelerate and increase the installation and deployment of renewable energy.

LONGER LEAD TIMES

Large-scale battery projects to store energy on grids and to smooth out the variance of wind and solar power are also seeing longer lead times. They are taking around 12 to 18 months to complete, around six months longer than they would take without the supply issues, said Andrew Waranch, chief executive of battery energy storage system developer Spearmint Energy.

That has improved since the summer, when completion time reached about 100 weeks, he said.

"The biggest bottleneck I face today, and most developers face today is (procuring) transformers, substation equipment ... simple, old-fashioned electrical engineering equipment," Waranch said.

Developers added a record 1,510 megawatts (MW) of grid-scale battery storage in the second quarter, according to a report from Wood Mackenzie and the American Clean Power Association. That, however, was lower than anticipated because of the supply chain problems.

For the full year, developers and power plant owners plan to add 9,400 MW of battery storage capacity to the existing total of 8,800 MW, according to the U.S. Energy Information Administration. The capacity is expected to nearly double again to reach 30,000 MW by 2025.

Swiss-based Energy Vault, which provides equipment and other services to power producers in the U.S., has started to bake in longer timelines and higher costs for storage projects to minimize the impact of delays, said Marco Terruzzin, chief commercial and product officer.

Utility AES Corp (AES.N) has stockpiled supplies of the equipment it needs to build battery storage projects through 2025, a company spokesperson said.

A shortage of raw materials that has contributed to transformer supply delays is unlikely to ease soon, manufacturers said.

Electrical steel supplies have been tight since the pandemic due to factory shutdowns in China, said Doug Banty, president and chief operating officer at MGM Transformer, a California-based transformer manufacturer.

"This is an industry that is not accustomed to rapid production expansion ... most of us are playing catch up," Banty said.

Export restrictions imposed on Russia after it invaded Ukraine exacerbated the shortages, said Banty.

The supply-demand dislocation has worsened with the rapid scale-up of wind, solar and storage projects.

U.S. producers have been slow to expand capacity due to the expense, John Darby, president of Niagara Transformer, a New York-based manufacturer.

Reporting by Nicole Jao; Editing by Simon Webb and Nick Zieminski

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