

# SAFETY ALERT



**Safety Alert No. 396**

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## **Risk of Fires from Adjustable Speed Drives (ASDs)**

In 2019, several fire incidents on the Outer Continental Shelf involved adjustable speed drives (ASDs), also known as variable frequency drives. These incidents included 1) overheating due to the effects of harmonic electrical currents, 2) short-circuit faults, and 3) moisture in the ASD cabinet, and all resulted in fire and arcing.

An ASD is a device used in electromechanical drives to control the speed and torque of an AC motor by adjusting the motor's input frequency and voltage. ASDs are often used to control the speed of compressors and pumps to adjust the flow through pipelines.



*Short circuit fault in the ASD*



*Arc damage to components*

### **Causes and Contributing Factors**

A review of the investigation reports for ASD incidents indicate that many are attributed to the following:

- A short-circuit developing into a line-to-ground fault. The resulting thermal stress caused a fire and arc flash within the ASD;
- Overheating, which caused failure of electrical distribution equipment, cables, transformers, standby generators, etc., because of harmonic currents introduced by ASDs; and,
- Moisture ingress resulted in the loss of the ASD.

**Therefore, BSEE recommends operators and contractors consider the following:**

- Establish and document monitoring procedures to identify potential problems associated with water ingress and overheating (e.g., periodic visual inspection and cleaning);

- Develop, document, implement, and maintain competency-based training systems, to include follow-up, so workers are continuously aware of the critical tasks involved with verification of the electrical installation and maintenance;
- Ensure installation practices are documented and meet fundamental electrical safety principles, including protection against overcurrent and earth fault current in accordance with API RP14F<sup>1</sup> & 14FZ<sup>2</sup>;
- Ensure ASDs are installed in a protective environment, free from dust and other abrasive materials, corrosive gases and vapors, flammable gases and liquids, and high levels of atmospheric moisture;
- Verify that short circuit and thermal protection systems are installed and maintained according to OEM instructions (ground fault relays, fuses and circuit breakers) to protect power cable, motors and input rectifier bridge;
- Ensure active or passive harmonic filters are installed to reduce or mitigate harmonics to tolerable levels as defined by IEEE-519<sup>3</sup>, IEEE1531<sup>4</sup>, API RP 14F and 14FZ, as determined by the power system documented analyses (i.e. harmonics analysis) or power quality monitoring;
- Use K-rated or Harmonic Mitigating Transformer (HMT) dry-type transformers in applications where most of the load is non-linear (e.g. ASDs, LED lighting, computers, UPS, etc.);
- Ensure all ASD metallic parts, both internal and chassis, are bonded together and grounded to earth to confirm safe touch voltage potentials exist in ground-fault conditions; and,
- Ensure the Safety and Environmental Management Systems (SEMS) tool is available to personnel and up to date, as required by 30 CFR 250.1900.

**All the above recommendations should be supported by documentation of policies and procedures and frequency checks.**

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<sup>1</sup> API RP 14F "Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Division 1 and Division 2 Locations"

<sup>2</sup> API RP 14FZ "Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations"

<sup>3</sup> IEEE-519 "Recommended Practice and Requirements for Harmonic Control in Electric Power Systems" defines harmonic limits within a power distribution system to assure proper equipment operation through its "Standard Practices and Requirements for Harmonic Control in Electrical Power Systems"

<sup>4</sup> IEEE-1531- "Guide for Application and Specification of Harmonic Filters"

<p>A Safety Alert is a tool used by BSEE to inform the offshore oil and gas industry of the circumstances surrounding a potential safety issue. It also contains recommendations that could assist avoiding potential incidents on the Outer Continental Shelf.</p>
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