Serious fires have broken out on vessels with FRP materials. They appear to have been caused by overheating of the FRP from hot exhaust systems. FRP is combustible and introduces several challenges compared to traditional non-combustible materials. It is imperative that safety barriers and fire safety measures are in place.

Course of events
On one vessel, a fire was thought to have originated in FRP panels above the exhaust in an area between the main engine room and the adjacent casing. Maintenance of the engines had previously been carried out, requiring removal of insulation.

On another vessel, a fire had likely started in a compartment with direct access to open air and adjacent to an auxiliary engine room. The engine exhaust is routed through the compartment housing the silencer or muffler. A low-pressure cooling water alarm was experienced followed by a high-temperature cooling water alarm, but without activation of the automatic engine shutdown.

The emergency situations created stress and confusion amongst the crew. The dilemmas were further compounded by the inappropriate location of on-board fire and evacuation procedures, which were also not properly understood or followed, causing wrong evasive actions. Amongst others, this resulted in the unintentional shutdown of generators, preventing operation of fixed fire-extinguishing equipment.

Extent of damage
In both cases, the fires were intense and spread rapidly, emitting dense smoke with hazardous toxic fumes. The fire on one vessel was contained, but with extensive material damage. The other vessel had to be evacuated and was declared a total loss. There were no reported injuries to any persons.

Probable causes
The immediate causes of the fires were likely due to a combination of missing insulation on FRP structural surfaces exposed to heat radiation or direct contact with hot exhaust parts and limited engine room ventilation. Overheating of exhausts could also develop suddenly due to insufficient cooling water. Other contributing factors might be issues with temperature sensors or the malfunction of the shutdown system.

Lessons learned
Rules and regulations
FRP vessels are normally subject to compliance with either the 2000 HSC Code and/or DNV GL rules for classification - High speed and light craft (RU-HSLC) - and any additional requirements from flag states. Requirements to FRP materials are governed by the DNV GL rules for classification: Ships (RU-Ship) Pt.2 Ch.3. The design, construction and arrangement of the vessels were found to comply with applicable rules and regulations at the time of construction.

It should be mentioned that the ignition point of FRP materials is typically around 275 to 375°C, which is relatively low compared to metallic materials, i.e. aluminium alloys or steel. Operating temperatures of engines and exhausts can be considerably higher, and there is an inherent risk of fire if safety measures are not satisfactorily arranged or managed. Therefore, due attention to design details should cover the following:

- Arrangement for cooling of the exhaust system using, for instance, water
- Safety barriers: alarms for high engine temperature, high exhaust temperatures and cooling water pressure, and automatic shutdown of the engine
- Alternative solutions, i.e. appropriate use of materials resistant to elevated temperatures that may occur in the event of a failure
- Fire protection, detection and extinguishing arrangements in spaces where exhaust systems are routed. Exhaust should not pass through spaces with access to open air.
- Engine room ventilation capacity and arrangement

DNV GL is presently reviewing the applicable regulations and classification requirements to ensure that a sufficient level of
details in this context is stipulated and practiced. This may lead to changes in the rules. If potential gaps in the regulations are identified, DNV GL will pursue and propose recommendations to be brought forward to the IMO.

**Recommendations**

Yards and designers:
- The machinery shall be designed to ensure the risks of fire are acceptably low; refer to the bullets mentioned under “Rules and regulations”.

Ship owners and operators:
- The machinery and associated parts are always to be kept well maintained and regularly checked under an inspection and monitoring regime, especially for control of hot spots and any signs of overheating. Where removal of insulation is necessary during modifications or other work, it is important that the insulation is correctly reinstalled and maintained to at least the original condition.

- The safety management system shall be suitable for handling emergency situations based on the design, construction and arrangement of each vessel. For an FRP vessel, a realistic response time from when a fire is discovered must take into account the potentially high escalation rate of the fire and any practical aspects, i.e. availability and access to equipment and instructions. Adequate training of the crew for emergency preparedness, especially for fires and evacuations, is an area of concern and proper guidance must be provided in the form of applicable on-board procedures, operating instructions and signboards, etc.

- As an immediate preventive measure, it is strongly advised that all relevant operational strategies are critically reviewed, amended as necessary and implemented without delay.

**References**

- DNV GL rules for classification: [High speed and light craft (RU-HSLC)]
- DNV GL Technical and Regulatory News: [Enhancing fire safety awareness (May, 2016)]

**CONTACT**

Approval, Section Passenger, Ro-Ro, Light Craft and Naval
MCANO872@dnvgl.com