

# Certification of the Polaris Rail Ranger

Alastair Roberts, Head of Certification (Plant) at AEGIS Certification Services, describes the work undertaken in certifying the first Fitzgerald Plant Services Polaris Ranger converted to rail use - The Polaris Rail Ranger.

## Plant approval

Road Rail Vehicles (RRVs) are machines which are converted to be used on rail by the addition of rail wheels/bogies and associated control systems, along with any modifications required in other areas of the machine to ensure they meet the relevant standards for use in the railway environment.

The process for approving machines for use on rail within a possession is detailed within RIS-1710-PLT. The specific technical requirements for RRVs are contained within RIS-1510-PLT, currently Issue 6. Whilst compliance to this Rail Industry Standard (RIS) is not a legislative requirement, it is mandated by Network Rail.

Each individual machine must be certified by a Plant Assessment Body (PAB) prior to use on the rail infrastructure. This certification is in the form of an Engineering Conformance Certificate (ECC), which remains valid for up to seven years from the date of issue. In addition to the ECC, each type of machine must also be granted Product Acceptance (PA) by the infrastructure manager.

Legislative requirements mandate that the machine is CE marked. RIS-1530-PLT requires that the harmonised standard for RRVs, BS EN 15746-2:2010+A1:2011, is used. Although CE marking is fulfilled by the manufacturer self-certifying the machine, as described in *Rail Infrastructure* Issue No: 135, this is also reviewed in part during the PA process.

AEGIS Certification Services has been an accredited PAB since December 2017 and authorised by Network Rail to undertake PA scrutiny since January 2018.

## Fitzgerald Plant Services

Following 10 years in the rail plant service and upgrade industry, Fitzgerald Plant Services (FPS) has begun production of its own RRVs. The first machine it has designed and manufactured is the Polaris Rail Ranger. Whilst RRV buggies are not new to the rail industry, FPS saw the potential for a new machine whilst, at the same time, providing innovative solutions. From the beginning, FPS intended the machine to be different to those currently on the market, enhancing the industry in several areas.

## Human factors

An important feature of the Rail Ranger is the human-machine interface. The system used is something you would normally see on larger, more expensive machines. All rail gear functions are controlled via the touch buttons on the in-cab display. Additionally, the machine status is displayed in real time, with the system providing diagnostic details and error reports on the machine.

As with larger machines, the rail equipment is deployed hydraulically. This removes the need for manual manipulation and setting of the rail equipment, or the potential to incorrectly set the machine up on track. As a type 9C low ride machine, the rail



wheels provide guidance only for itself. All tractive and braking effort is provided by the road wheels. The critical road/rail wheel loading is monitored and controlled by the intelligent control system.

The machine is supplied with a fully-enclosed cab. Amongst other items, this includes a heating and ventilation system for passenger comfort. Whilst features such as cab heaters, windscreen wipers and such remain an option on the machine's specification from Polaris, they are required to CE mark the machine to the RRV harmonised standard and are, therefore, mandated by the infrastructure manager. The cab provides fixed seating for up to six personnel, enabling safe, comfortable transport to the site, with a rear load area for the transportation of small tools.

## Machine testing

To demonstrate the machine meets the requirements of both RIS-1530-PLT and PA, the machine was extensively tested at both the FPS workshops at Cwmbran and the Pontypool and Blaenavon Railway.

Track testing at Blaenavon focused on



demonstrating the machine's towing abilities, braking performance, prevention of derailment and compatibility with required track geometry and features. Testing included a range of activities in both the laden and unladen condition of the machine. This is to ensure that the most adverse conditions are used for each test scenario.

Although the machine has no working mode, and the requirements of the emergency recovery system are greatly simplified, the system was also tested on-site to demonstrate it was fit for purpose, enabling the machine to be recovered from rail in the event of machine failure.

Static testing, conducted in a controlled workshop environment, focused on the critical relationship between rail and road wheel loading. This is particularly important as the mass of the machine changes due to alterations in the payload and the number of passengers being transported.

Other testing covered DQ/Q over the full range of track conditions including maximum cant, gradient and track twist; impedance testing of the earth bonds to allow the machine to be used under both live and isolated overhead line equipment; noise emissions and testing of the park brake to simulate holding a fully-laden machine on the maximum gradient.

## Towing

Machines of this type are often used to tow small trailers to and from the worksite. Typically, these trailers have 'single line' park/service brake systems controlled by either hydraulic or pneumatic systems.

To ensure compatibility with as many of the existing and potential new trailers on the rail network, and to comply with the relevant railway standards, this machine is fitted with single line hydraulic and dual line pneumatic trailer brake systems. The machine can, therefore, be used with all existing trailer types approved for use on the network.

It is envisaged the machine will be used with either bespoke 2 tonne trailers or the more usual rail trailers found on the

network, such as Chieftain, GOS, Rexquote, etc. During testing, the machine successfully demonstrated it met all the requirements to enable it to tow trailed loads of up to 10 tonnes. This towing capacity is significantly more than similar RRV buggies and greater than road/rail machines such as Land Rovers and other jeeps.

### Electromagnetic compatibility

As often is the case with RRVs, the base machine may not be able to demonstrate that it meets the requirements of the rail industry in terms of Electromagnetic Compatibility (EMC). As the base machine's declaration of conformity did not specify EMC standards with an equivalence to EN 50121-3-1 and EN 50121-3-2, the machine was subjected to full testing by a UKAS-accredited test organisation to these standards.

Meeting the requirements of these EMC standards demonstrates that the machine will not adversely affect any railway systems, including the signalling system of which it is in the vicinity. Neither will it be affected by EMC emitted from other systems on the railway infrastructure. In part, compliance with these standards will enable the machine to be used Any Line Open (ALO).

### Structural verification

Items of On-Track Plant (OTP), which are being upgraded after seven years, are usually able to demonstrate their suitability for continued use from their historic service record. Specifically, clause 5.29.1 of RIS-1530-PLT states 'written evidence that the stress levels are acceptable through the safety record of



machines having a comparable design with the same or greater wheel loadings. It shall be based on a minimum of 1,000 hours of normal operation.'

As this is a newly-designed and built machine, compliance to this clause could not be demonstrated. Therefore, to provide 'evidence by calculation and/or measurement that the stress levels are acceptable for a minimum of 5,000 hours normal operation', extensive Finite Element Analysis (FEA) of the rail equipment was undertaken by FPS and provided to AEGIS Certification Services.

This evidence was used to successfully demonstrate the suitability of the structure of

the rail conversion. The exercise was also used as a final-year project for an AEGIS Certification Services student studying for their mechanical engineering degree. Upon completion of the course, the student was awarded a first-class honours degree.

Whilst FPS is contracted to maintain many items of OTP in the UK, the company utilised its specialist knowledge in this area to optimise the maintenance requirements for the machines. Following the review processes above, AEGIS Certification Services was able to issue a First of Class ECC and make a recommendation to Network Rail to issue Product Acceptance for the machine type.