

Graham Haywood, Locomotive Applications Engineer for United Goninan, was one of the principal designers of the new GL Class locomotive. In the following article, he presents a technical overview of the rebuilding of a 442 Class locomotive into a new 3000HP, 132 tonne GL Class locomotive

Above: GL103 and GL104 undergo fine tuning at the United Goninan Broadmeadow Plant in NSW on 11 September 2003.

Photo by Stuart Ellis

THE GL CLASS:- A TECHNICAL OVERVIEW





The "GL" class was developed from a need to supply a low cost 3000hp dual cab locomotive for the CFCLA lease fleet.

To meet the need, surplus C30-7A locomotives in the United States of America were identified to provide the engine and propulsion kit to be installed into a package that would meet the rolling stock outline of Australian Railway standard gauge.

A suitable existing locomotive for rebuild was considered to be the Goodwin/Alco Locomotive, otherwise known as the 442 Class from Freightcorp.

Known operator issues with the 442 class locomotives were the following:

- Access doors hit the back of operator seating
- Poor collision protection for the operator'
- Fumes entering the No 2 or 'B' end operator cab
- High noise level in the operator cabs

A new design using the existing platform and bogies was prepared to answer the aforementioned issues and also to accommodate the donor engine and propulsion kit.

A new design 16mm thick formed steel nose and collision posts was welded to each end of the locomotive. The nose also had two integral sand boxes and

included an anti-climber structure. Thus, a much improved collision protection for drivers and observers.

The existing operator's cab used on the QR 2800 class CM30-8i 'B' end was used as a base design for a new resiliently mounted operator's cab for both ends of the rebuild locomotive. Changes included side access doors, roof mounted air conditioner and left hand side driving desk and console. Thus improved roll over protection with increased cab length was achieved. Heat and noise insulation was included in the ceiling and cab walls to reduce noise levels.

Changing the installed engine power from 2000hp to 3000hp required an increase in fuel tank capacity. New design saddle tanks enabled an increase to 7500 litres usable fuel tank capacity. This increased capacity would provide an operational range comparable to the "EL" class locomotives.

To contain the external noise level of the locomotive an Australian company was entrusted with the task of designing, building and testing an engine silencer that would meet the specified engine exhaust noise levels for the 7FDL12 diesel engine.

An increase in installed engine power required an increase in the engine coolant radiator capacity. The 442 class locomotive was fitted with two inclined roof mounted radiators. A shaft driven

Above: The CFCLA trio of GL102 Sunline, EL64 Super Impose and EL62 Archer have emerged from Boronia No 1 Tunnel, on their ascent of Cowan Bank with LVRF's 4168 Freight from Sandgate to Port Botany, on Friday 29 August. Cowan Bank is located on the northern outskirts of Sydney, in NSW.

Photo by Jason Ferguson

cooling fan drew air through the radiators and exhausted through the central roof outlet.

The new design used two new larger capacity side frame mounted radiators with the donor C30-7A locomotive providing the shaft driven eddy current clutch speed controlled cooling fan.

Due to design differences between the ALCO and GE engines, the larger oil cooler and oil filter from the donor C30-7A locomotives were also used replacing the former ALCO items.

The existing 3CDC air compressors of the 442 class locomotive were overhauled and re-used.

To provide cooling air for the traction motors, electrical machines and electrical cabinets the larger and higher air flow capacity shaft driven equipment blower from the C30-7A donor locomotive was overhauled and used.

A new blower cab with end partitions incorporated body side mounted panel air filters. This new blower cab thus formed a clean air compartment to supply the equipment blower. A new battery box was integrated into the blower cab side with an externally accessed air

brake rack mounted on top of the battery box.

To modernise the air brake system desk mounted independent and automatic brake valves were incorporated. Also the increase in service mass from 115 tonnes to 132 tonnes required a re-design of the braking system. To enable operation of the locomotive on ARTC track, the braking system had to be redesigned to enable the locomotive "Holding Brake" to hold on a grade the train mass the locomotive could haul up the grade.

Thus the locomotive was designed to provide five braking systems.

1. Park brake for the locomotive – push button operated spring applied and air pressure released.
2. Independent brake to provide a straight air pneumatic brake for light engine operation.
3. Automatic brake to provide an air pressure equalised braking system for the train brakes.
4. Holding brake system where brake cylinder pressure was increased to lock the wheels.
5. Dynamic brake system where the traction motors are charged into generators and the energy generated charged to heat by resistors.

Even with consideration of the five braking systems to obtain sufficient retarding force at the wheels the same high static friction non-metallic composite brake shoes as used on the NR class locomotives were included.

Also the 8 inch brake cylinders were changed to 9 inch donor cylinders excepting for the 8 inch HSL spring park brake cylinders. A change in the ratios of the horizontal and vertical brake levers was also required to provide sufficient braking power.

A new engine cab canopy including sides and roof was designed to replace the former engine hatch.

The new engine cab canopy included gull wing hinged covers to enable power assembly changes without removing the engine cab. Also lessons learned from the "EL" class locomotive were included with port hole roof mounted

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windows, for increased natural light, and bi-fold side doors to enable both maintenance access with also a rapid engine cool down.

An innovation tried on this locomotive was to pipe toilet air to the crankcase ventilation blower. Thus ensuring a ventilation of the toilet whenever the engine was running.

The DC generator of the 442 class was changed to an AC alternator with the alternating current then rectified to DC to power the traction motors. The use of an AC alternator enabled a rapid field current control with a consequent alternator output current control. This rapid control of the alternator output enabled the effective use of a microprocessor wheel creep control system. Thus a higher adhesion limit with a higher tractive effort for any rail condition compared to the original 442 class system.

Incorporated in the microprocessor (GE Brightstar) control system was a diagnostic capability for improved fault identification and a Diagnostic Information Display (DID) to inform a driver and maintenance staff of such a fault.

Protective systems were also included into the "Brightstar" control to protect from over voltage, over current of the alternator and traction motors.

Thus the 2000hp 442 class was rebuilt into a 3000hp C30-MMi model locomotive using overhauled GE Dash 7 components, updated with a modern control system, to provide a dual cab locomotive with equivalent performance, or better, to a 81 class locomotive at a fraction of a new locomotive price.

Below: A view of several GL Class locomotives under construction inside United Goninan's Broadmeadow (NSW) manufacturing plant on Thursday 4 September. In the foreground is the roof of GL107, while GL103, GL105 and GL106 receive attention in the background.

Photo by Stuart Ellis

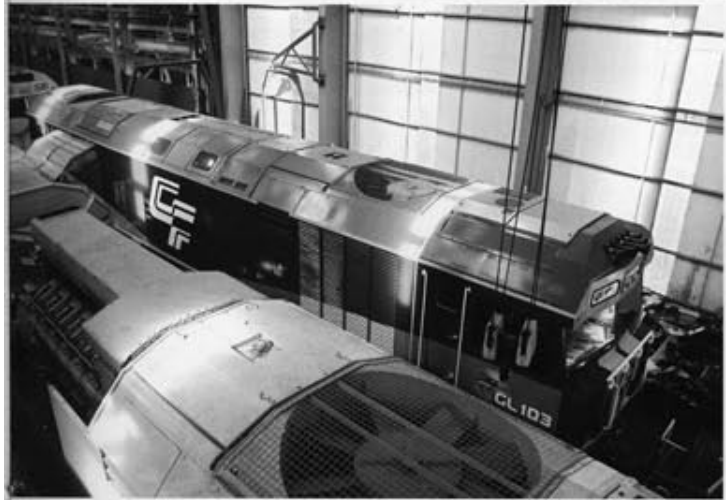
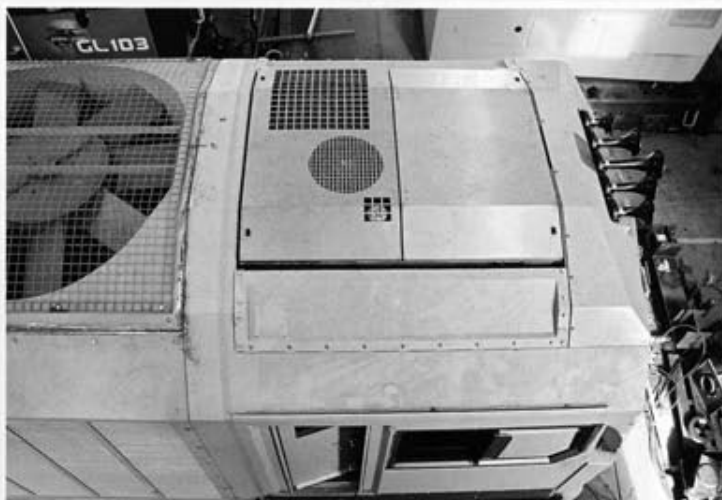
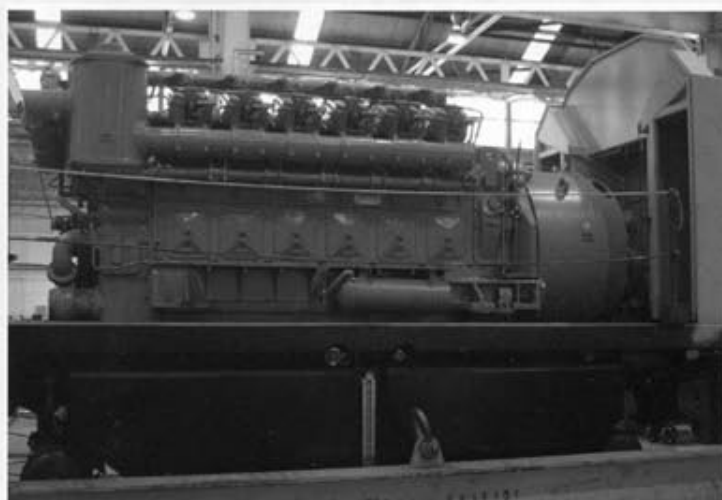


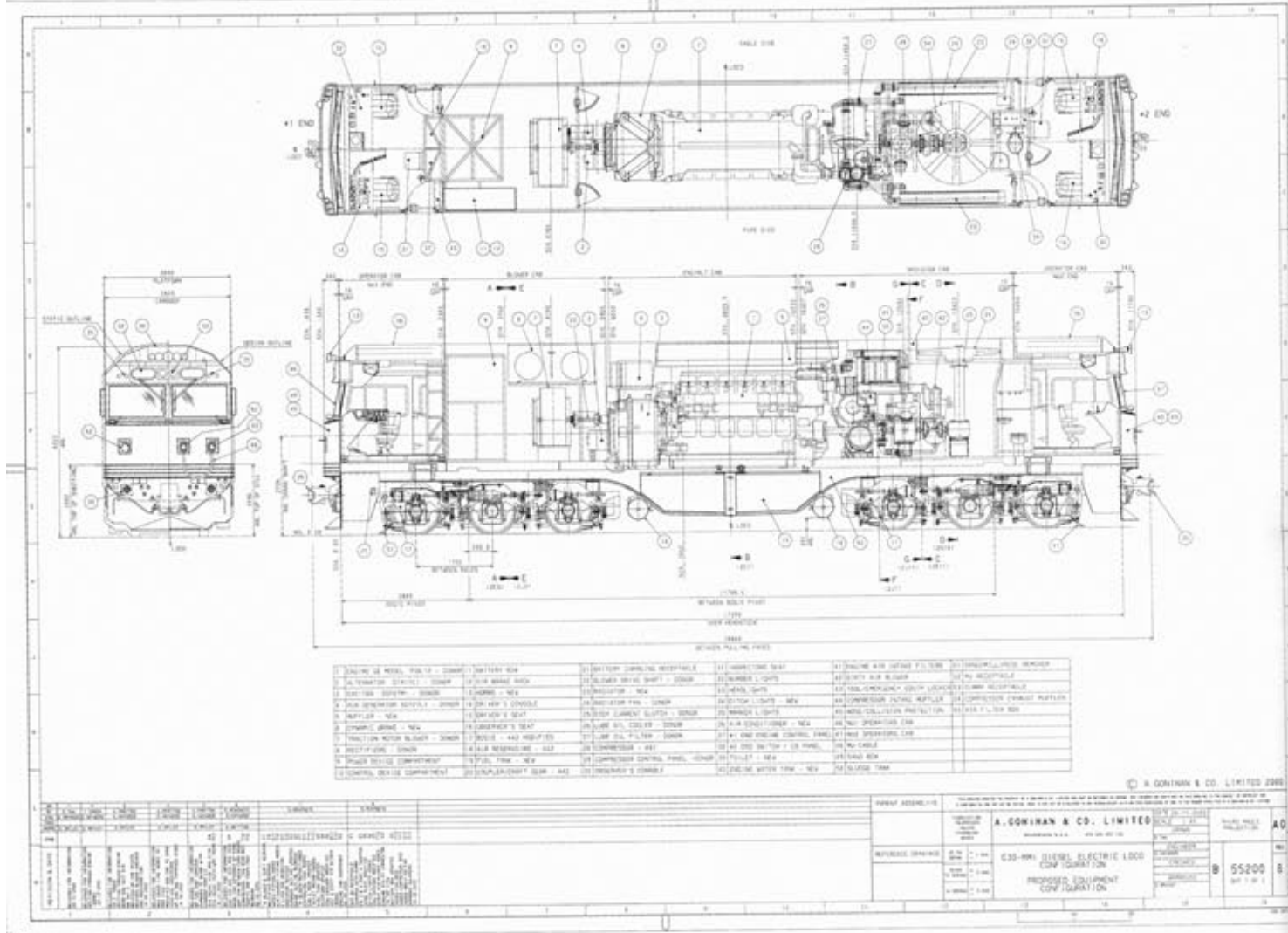


Opposite page: Various images of GL103 Brew at United Goninan Broadmeadow, on Thursday 11 September.

Clockwise from top right: GL108 is shown receiving its air compressor, a 7FDL12 3300HP engine sits on GL108's platform, a view of the No 2 End roof of GL107, the fuel tank of GL104, bogies and steps on GL104, an elevated view of GL107 and GL103, and the muffler attached to the engine of GL107.

All photos on both pages by Stuart Ellis

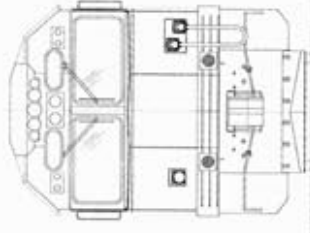




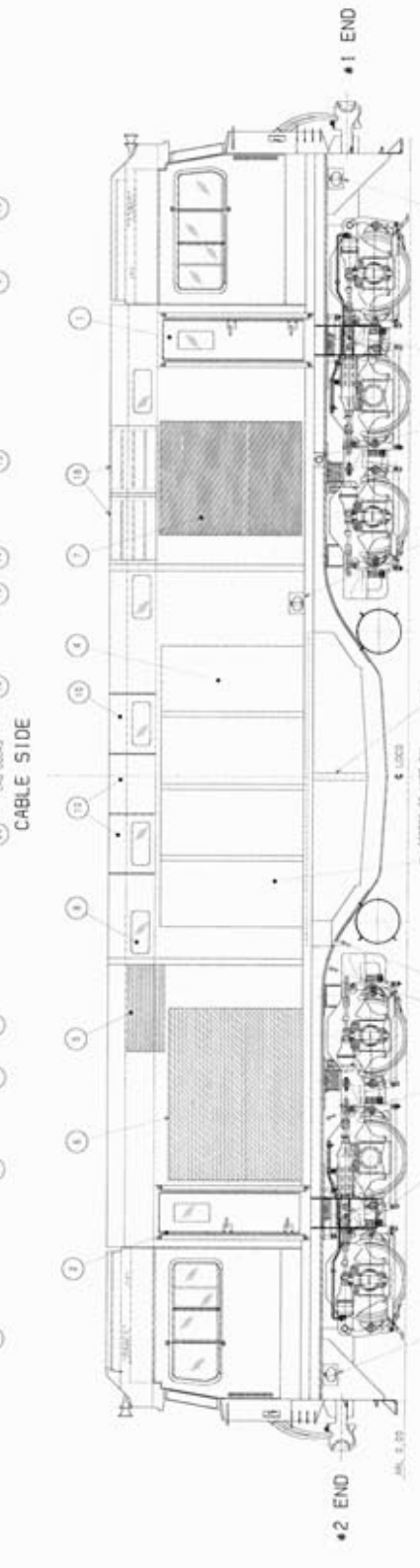
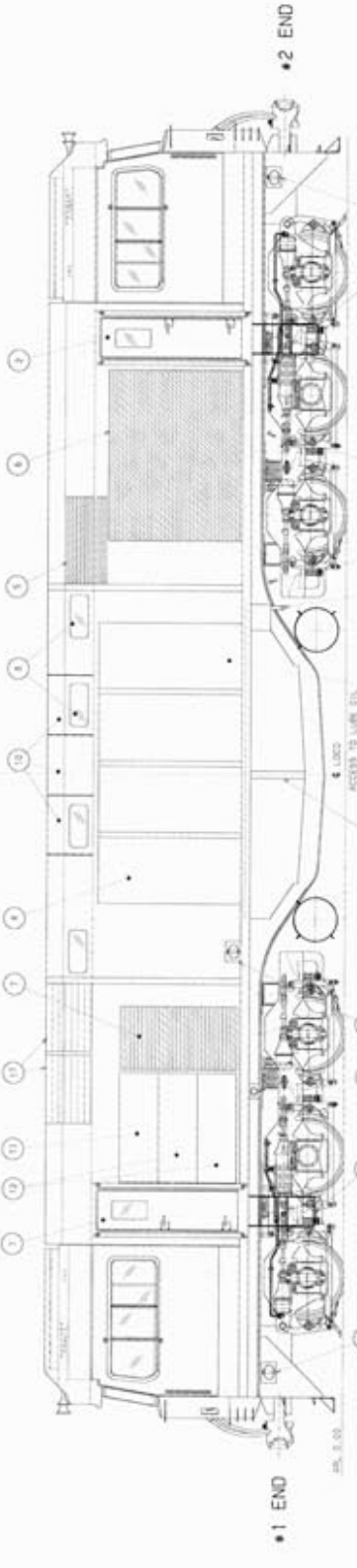
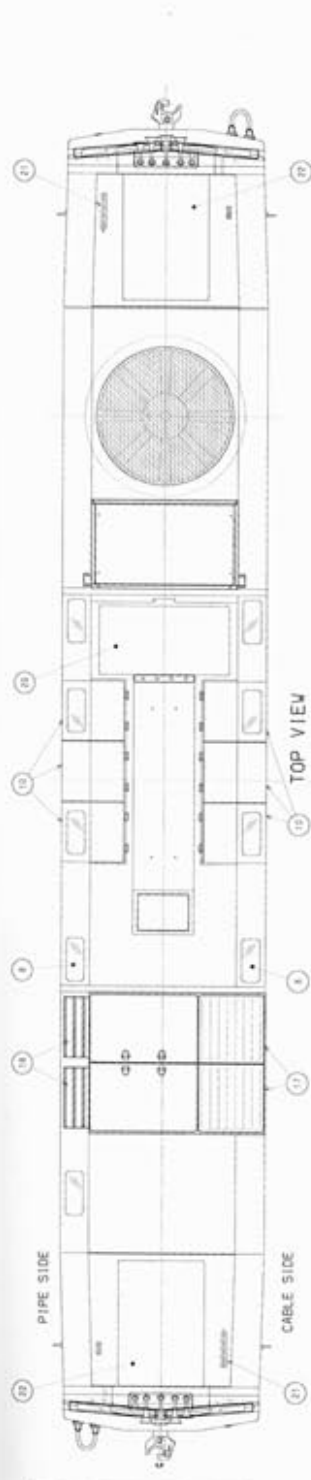
Above and left: Inside the No 2 End operator's cab of GL103 at United Goninan Broadmeadow, on Thursday 11 September.

Photo by Stuart Ellis

- 1 #1 END DOOR (DUAL DOOR HANDLE)
- 2 #2 END DOOR (DUAL DOOR HANDLE)
- 3 FUEL FILL LOCATION
- 4 ENGINE CAB ACCESS DOORS
- 5 ENGINE FILTER AIR INLET
- 6 RADIATOR INLET VENT
- 7 BLOWER AIR INLET
- 8 OVER HEAD WINDOWS
- 9 ACCESS STOPS
- 10 COLLING AIRFORES
- 11 AIR BRAKE ACCESS
- 12 BATTERY BAYS
- 13 SAND FILL LOCATION
- 14 COOLANT FILL LOCATION
- 15 INITIAL WATER FILL LOCATION
- 16 ENGINE LUBE OIL FILL
- 17 DYNAMIC BRAKE AIR INTAKE
- 18 DYNAMIC BRAKE AIR EXHAUST
- 19 SLODGE TANK DRAIN PIPE
- 20 MUFFLER
- 21 RADIO ANTENNA
- 22 AIR CONDITIONER
- 23 FUEL LEVEL GAUGE
- 24 BATTERY CHARGING RECEPTACLE



TYPICAL END VIEW



MODEL NO. 442 SERIAL NO. 55195 DATE 11-15-55		A.GONINAN & CO. LIMITED 442 CLASS LOCOMOTIVE RECONFIGURATION EXTENDING VENT PLATION & LUBRICANT COMPARTMENT		DRAWING NO. B 55195 4 SHEET NO. 1 OF 1
PROJECT NO. 442-1 DRAWING NO. B 55195 4 SHEET NO. 1 OF 1		A.GONINAN & CO. LIMITED 442 CLASS LOCOMOTIVE RECONFIGURATION EXTENDING VENT PLATION & LUBRICANT COMPARTMENT		DRAWING NO. B 55195 4 SHEET NO. 1 OF 1
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APPROVED BY: [Signature]		A.GONINAN & CO. LIMITED 442 CLASS LOCOMOTIVE RECONFIGURATION EXTENDING VENT PLATION & LUBRICANT COMPARTMENT		DRAWING NO. B 55195 4 SHEET NO. 1 OF 1

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NSW GL Class - Full Sectional Loads (approved by RIC)

SOUTH

Sydney to Goulburn 1780t
 Goulburn to Demondrille 1130t
 Demondrille to Junee 1500t
 Junee to Albury 1650t
 Albury to Junee 1650t
 Junee to Moss Vale 1840t
 Moss Vale to Sydney 2500t
 Junee to Narrandera 1400t
 Narrandera to Griffith 2100t
 Griffith to Grong Grong 1400t
 Grong Grong to Junee 2100t
 Goulburn to Tarago 1400t
 Tarago to Canberra 1130t
 Canberra to Tarago 1130t
 Tarago to Goulburn 1525t
 Cootamundra to Temora 2000t
 Temora to Griffith 2100t
 Griffith to Temora 2500t
 Temora to Cootamundra 2000t

NORTH

Sydney to Broadmeadow 1130t
 Broadmeadow to Sydney 1130t
 Broadmeadow to Grafton 2100t
 Grafton to Casino 1900t
 Casino to Acacia Ridge 1800t
 Acacia Ridge to Casino 1800t
 Casino to Grafton 1900t
 Grafton to Broadmeadow 2100t
 Broadmeadow to Muswellbrook 1650t
 Muswellbrook to Werris Creek 1130t
 Werris Creek to Moree 1400t
 Moree to Werris Creek 2100t
 Werris Creek to West Tamworth 1130t
 West Tamworth to Werris Creek 1130t

WEST

Sydney to Lithgow 750t
 Lithgow to Parkes 1130t
 Parkes to Lithgow 1130t
 Lithgow to Sydney 1130t
 Lithgow to Kandos 1131t
 Kandos to Lithgow 1131t

Orange East Fork to Dubbo 1130t
 Dubbo to Orange East Fork 1130t
 Dubbo to Talbragar 2000t
 Talbragar to Dubbo 2500t
 Muswellbrook to Dubbo 1410t
 Dubbo to Muswellbrook 2106t
 Werris Creek to Dubbo 2010t
 Dubbo to Werris Creek 2055t
 Parkes to Dubbo 2106t
 Dubbo to Parkes 1650t
 Cootamundra to Parkes 2000t
 Parkes to Cootamundra 2230t
 Dubbo to Cobar 1650t
 Cobar to Dubbo 2106t

ILLAWARRA

Sydney to Bomaderry 1130t
 Bomaderry to Sydney 1400t
 Port Kembla to Moss Vale 750t
 Moss Vale to Port Kembla 1840t

NOTES: When different classes of locomotives are mixed, generally the NSW Rail Infrastructure Corporation (RIC) will stipulate that the overall load haulage capability must be reduced by 10%, because of the different balance speeds of the classes involved. When the tractive effort - speed curves for the different classes are close, the 10% reduction may not apply.

With the GL Class locomotives, when they are mixed with EL, NR, C, L, 47, 48, 49, T and 830 Classes, the overall load haulage capability must be reduced by 10%. When mixing with all other classes that are authorised to operate in NSW, the 10% reduction does not apply.

GL Class - Names

GL101 Think Big	GL107 Rogan Josh
GL102 Sunline	GL108 Rain Lover
GL103 Brew	GL109 Just A Dash
GL104 Jezabeel	GL110 Tawriffic
GL105 Let's Elope	GL111 Galilee
GL106 Subzero	GL112 Jeune

Above: LVR's 4168 Freight from Sandgate to Port Botany rolls through Niagara Park (north Gosford, in NSW) behind GL101 **Think Big**, EL62 **Archer**, and R&H Transport liveried JL404, on Wednesday 30 July.

Photo by Stuart Ellis

GL CLASS - TECHNICAL SPECIFICATIONS

Model designation: C30-MMi
 Wheel arrangement: Co-Co
 Maximum speed: 112.8km/h
 Maximum tractive effort: 490kN
 Continuous tractive effort: 347kN @ 20km/h
 Engine: GE-7FDL-12 (turbocharged)
 Wheel diameter (new): 1016mm
 Wheel diameter (condemning): 954mm
 Gross power of engine: 3300HP
 Power available for traction: 3000HP
 Alternator - Traction/auxiliary: 5GTA11C2
 Traction motors (white metal bearings on axle): 5GE752AF11
 Control system: GE Brightstar
 Radiator fan: Eddy current clutch driven from engine
 Equipment blower: Driven through gear box coupled to crankshaft
 Air compressor: Westinghouse 3CDC, shaft driven from engine
 Fuel capacity: 7500 litres
 Lubricating oil capacity: 776 litres
 Cooling water capacity: 1436 litres
 Sand capacity: 0.566m³

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