Sustainable speed

Davidson Ward, John Rhodes, G Rob Mangels and Shaun McMahon, Executive Directors of Sustainable Rail International, describe the latest development in high-speed steam and how they intend to make it sustainable.

BY SUSTAINABLE RAIL INTERNATIONAL

"Our object in travelling should be, not to gratify curiosity, and seek mere temporary amusement, but to learn, and to venerate, to improve the understanding and the heart." - Sir Herbert Nigel Gresley

It is the ever present will to learn, improve technology and follow the spirit of the great steam locomotive mechanical engineers that drives those involved with the Coalition for Sustainable Rail's "Project 130" to pursue the reinvestigation of steam traction as a type of higher-speed passenger rail motive power.

The Coalition for Sustainable Rail (CSR), led by United States not-for-profit Sustainable Rail International (SRI) and the University of Minnesota (UofM), is dedicated to returning steam technology to the international transportation conversation. By refining and applying a revolutionary biofuel to the transportation industry in a manner not afforded by internal combustion, CSR is working to advance steam technology with an international team of researchers and supporters. This will be built upon the successes that Gresley, Andre Chapelon and the great engineers at ALCo, Lima and Baldwin achieved in the steam era.

Background of CSR Project 130

Like the readership of this magazine, the founders of CSR have a deep, long-standing fascination with steam technology, but the keepers of that technology have all but vanished from the transport industry. When U.S. politicians talk about high speed trains that travel at 110mph (such as the new Chicago to St. Louis corridor), CSR's engineers recall the Milwaukee Road's famous Hiawathas, steam-hauled trains that ran at 100+mph daily just to keep on schedule. After taking into account rising fuel costs, diesel emissions and the fact that steam locomotive technology has improved significantly since the 1950s, it became strikingly clear to CSR that alternatives should be investigated.

The authors of this article began to look into the possibility of clean fuel specifically for steam locomotives and, with the U of M, chose torrefied biomass, or 'biocoal'. Torrefaction, an up-to 96% thermally-efficient conversion process, is able to transform solid, dry biomass into a biocoal that has the same energy density and grindability as coal, without the attributable ash, heavy metals or net carbon output.

With the U of M as a collaborator, CSR began searching for a locomotive that could easily achieve current U.S. demand for non-electrified HSR performance (110-125mph), and the most logical choice was the last

As they were! Santa Fe 4-6-4 No. 3462 rolls train No. 28 into Lawrence, Kansas, at 0850 on a frosty January 29 1951. ROBERT P OLMSTEAD/CLASSIC TRAINS COLLECTION

The challenger (but not a 'Challenger') - Baldwin 4-6-4 No. 3463, which will be equipped with a boiler capable of holding 300psi of pressure. PROJECT 130

Right: The '3460' class were no strangers to speed with class pioneer, No. 3460, being fitted with streamlined casing. The locomotive leans into a curve with the 'Oil Flyer' at Dewey, Oklahoma, in May 1951. E C CLEWER/CLASSIC TRAINS COLLECTION

remaining 'Super Hudson'.

Locomotive 3463

Enter: the Great Overland Station. An exquisitely-restored passenger depot in the Capitol of Kansas, a state known more for tornados than trains, the Great Overland Station (GOS) owned the last of the 'Super Hudsons', of which only 21 were built for three railroads.

Former Atchinson, Topeka & Santa Fe 4-6-4 locomotive No. 3463 had been given to the City of Topeka in 1957 following its retirement. Toiling in a city park until the 1980s, a small group of dedicated volunteers began the arduous task of trying to rebuild the locomotive. This group was full of heart but cash-starved and its activity waned over time.

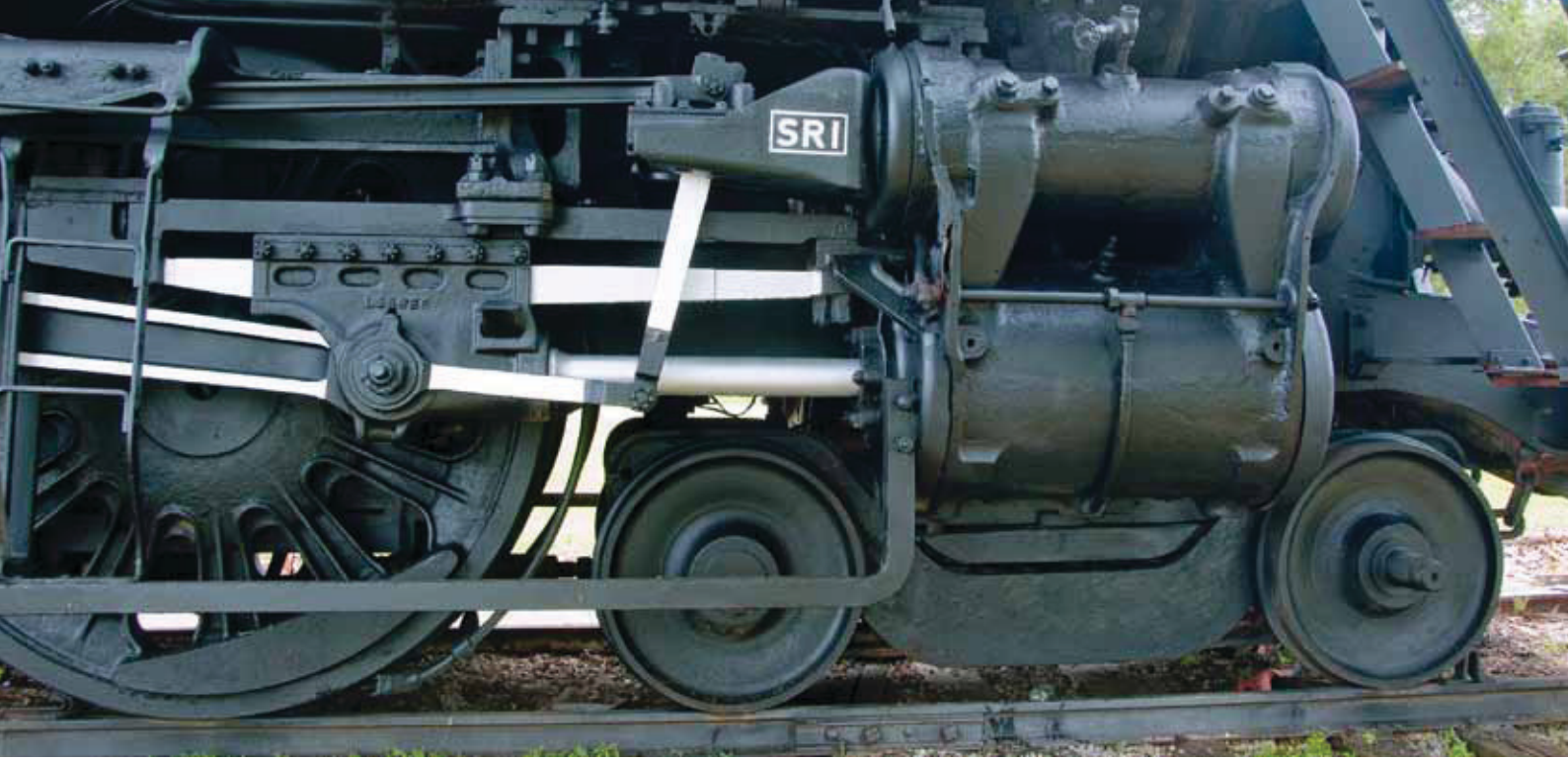
By the time CSR staff took their first visit to Topeka, the locomotive had gone decades without repainting, and it stood forlorn, rusting, surrounded by weeds. It had been given to the recently-formed Great Overland Station, which is situated three miles and across a river from the locomotive. Already to a point of severe degradation (e.g. almost every flexible staybolt cap on the firebox was rusted through), GOS was eager at the opportunity to see the locomotive go to good use and return to the rails. A mutual agreement was reached and, in November, 2011, ownership of No. 3463 was transferred to SRI.

For the task at hand, there is no better locomotive than 3463. Complete with 300psi boiler, one-piece cast frame, roller bearing axles and 7ft driving wheels, the locomotive is more than twice the size and horsepower as the famed 'A4' class, also built the same year. The '3460' class locomotives ran from Chicago to La Junta, Colorado, daily, a distance of just over 1,000 miles (or the equivalent of London to Inverness and back every day). Track speed was 90mph on much of the run, but the engines were known to have safely traveled well in excess of 100mph, often limited by the willpower of the driver.

For all of its high points, however, the '3460' class has a few design shortcomings, all of which will be remedied by CSR through logical and well-proven modernisation engineering techniques.

The Plan

CSR Project 130 has a conceptually simple goal: push current steam technology and torrefied biomass research as far as realistically possible, combining each to demonstrate the viability of modern steam locomotion. In other modern steam projects of the past 30 years, a great deal of engineering was performed on paper and on non-systematic upgrades to varying locomotives, all of which aided the science. But without a completely upgraded tangible test locomotive to point to, the technology proved impossible to quantify. Instead of beginning from scratch with a new-build steam locomotive, a comparatively exorbitant expense to prove a concept, CSR believes that modernising No. 3463 will result in many added research benefits, including: 1) having a locomotive that has a benchmark of data recorded on the locomotive "as-built"; 2) the ability ➛



Above: Baldwin's '3460' class had two outside cylinders measuring 23 ½in x 29 ½in, and laid down a tractive effort of 49,000lbs. Speeds up to 90mph were the norm for these 'Super Hudsons'. PROJECT 130

Right: Bette Allen of the Great Overland Station, and CSR president Davidson Ward, stand with No. 3463. PROJECT 130

to demonstrate with a 70+ year old locomotive that steam technology can outperform diesel-electric in horsepower and carbon emissions and 3) the ability to save No. 3463 from its own slow self-destruction and return an important survivor to steam.

The execution of Project 130 will take place in five discrete steps, none-of-which will be undertaken without proper financial resources needed to prevent missteps: 1) incorporate CSR, develop a formal relationship with the U of M and acquire a locomotive (this step has already been completed); 2) move the locomotive from its present location in Kansas to Minnesota; 3) complete an in-depth engineering survey and design schedule specifically tailored to 3463; 4) rebuild and modernise the locomotive according to step three, and 5) operate the locomotive at a designated test plant facility and, upon completion, carry out in-service testing on a predesignated railway line. Funding has been secured for the first two steps and CSR is working diligently with research partners to fund the remainder of the project.

In terms of modern steam technology needed to address the few "shortcomings" mentioned, CSR intends to employ the most up-to-date computer modeling to address issues of staybolt stress, heat exchange, driving wheel counter balancing and entire thermodynamic circuit. Technologies pioneered by L D Porta, David Wardale and S T McMahon in the realm of the Gas Producer Combustion System, Porta Boiler Water Treatment, Lempor Exhaust and additional, smaller advances, will be applied in order to increase power and decrease component maintenance demand and cost. As built, No. 3463 was non-streamlined, but using the streamlined design of sister No. 3460 as a starting point, CSR will shroud the locomotive in order to cut down on wind resistance.

As to the fuel type, though No. 3463 burned fuel oil throughout its career, the original locomotive designers intended for it to be readily converted to solid fuel, including castings to hold stoker components, grate bars and shakers, all with a tender that could be converted from liquid to solid fuel with ease. The employment of a GPCS firebox has already proven highly successful on multiple lines, including the Rio Turbio Railway in Argentina, on which Porta converted the locomotives to burn an exceedingly low quality coal. CSR is confident, thanks to combustion tests, that the locomotive will have little difficulty burning biocoal, which is of better quality than the coal used on the Rio Turbio.

Benefits of CSR Project 130

It is time to reintroduce the steam locomotive as a viable candidate for use in the 21st century, and the first step towards doing so is proving that such can be done. Divorcing itself from the smoke-belching behemoths they once were, CSR intends to demonstrate how far steam locomotive technology has come in the past 70 years.

Our leadership is confident that this project will serve to make the public aware of the capabilities of modern steam traction. As a melding of multiple disciplines, the attention this project has received in just its first few months has been astounding. It is not simply a replica project. It is not simply biofuel burned in a power plant. It is a serious attempt to return to a technology that has been all but ignored in the conversation of the future of non-electrified motive power.

Not just a steam locomotive project, the modern boiler and clean combustion fuel technologies associated with Project 130 are perfectly suited to the creation of small and medium-scale modern steam generator sets for use in developing countries. Employing the same low-maintenance characteristics of modern steam locomotives, these efficient, quiet generators, capable of burning locally-available waste biomass fuel will be of significant benefit to developing as well as developed countries.

CSR has worked diligently since incorporation in early 2011 to assemble a group of international steam locomotive and biofuel engineers and supporters and, although this project is taking place primarily in the United States, its founders understand that it is only through the support and interaction of our global community that it can hope to achieve its goals. Preserving heritage items and the moments of glory that go with them should not be mixed up with modern day developments; they are two totally different matters.

Celebrating *Mallard's* 75th anniversary of breaking the world steam record is very important to everyone in the steam railway industry, including the CSR team, and Project 130 should not be compared with this record-breaking event of 75 years ago. *Mallard* will always stand as the fastest official traditional steam locomotive, a tribute to the mechanical engineer who pioneered so much in the UK and overseas railway industry. In looking to push the technology forward, however, it is only logical 75 years later that a modern steam locomotive should be required to demonstrate its ability to run in excess of the aforementioned 125mph service range.

As yet, there is a great deal of ground to cover by CSR in order to achieve its goals; its founders understand that. However, through a dynamic and efficient international coalition, the future of steam locomotion will be positively positioned within the rail transport network. SR