SeaChanger Nemo

By: Mike Wood

Figure 1: Fixture as tested

It's been over three years since we reviewed the SeaChanger XG; it represented a slight departure for this column, as it was an accessory color changer for the ETC Source Four, rather than a luminaire in its own right. Since then, SeaChanger has started manufacturing complete luminaires as well as color changers, and this month's subject, the Nemo, is almost one of them. I say "almost," because the Nemo is not quite a full luminaire. It's a lot more than an accessory, as it now includes a light source and primary optics; however, it still utilizes the lens barrels of the Source Four for its output optics. In this case, the tables have perhaps been turned, and it's the Source Four lenses that are now an accessory for the Nemo.

The reason SeaChanger has made this change and started manufacturing light sources is primarily so that it can utilize the LiFi plasma light source from Luxim and capitalize on its long life and high efficacy. How well has SeaChanger made the transition from accessory to luminaire? Hopefully, this review will help you answer that question for yourselves, as we follow the usual path of measuring everything possible and giving you the data to help make an educated decision.

The SeaChanger Nemo is fitted with universal power supplies for both lamp and electronics rated from 100-240V 50/60Hz and, for these tests, was run from a nominal 115V 60Hz supply. I used a Source Four 26° standard-definition lens tube as my test output lens. I chose the 26° as it's the most common lens used on the Source Four. The Nemo can be run either with the power supply at the bottom, as illustrated in Figure 1, or inverted, with the power supply upwards.

Light source and primary optics

The SeaChanger Nemo uses the LiFi STA-40-02 plasma lamp, manufactured by Luxim. We've discussed other variants of this lamp and its operation in these reviews before, so I won't repeat myself too much. The salient features of the LiFi lamp that are important to the Nemo are its long life, high efficacy, and good color-rendering. Interestingly, Luxim quotes various lifetimes for its lamp types up to 30,000 hours, so SeaChanger is arguably being conservative with the 15,000 hours it claims for the lamp in the Nemo. Whichever it is, both 15,000 and 30,000 hours are very respectable figures, which represent many years of typical use in an entertainment venue. The lamp spectrum, when run at full power, is shown in Figure 2, and I measured a correlated color temperature of 4,900K from this. Note that the spectrum is nicely continuous with energy at all wavelengths. There are a few spikes but no big discontinuities, this leads to a good claimed CRI of 92.

The LiFi lamp itself is supplied by Luxim as a module complete with its heat sink, as shown in Figure 3. As most people will never need to change it, there is some disassembly required to get to the lamp capsule but, once the back end and rear handle are removed, you can slide out the entire assembly and its carrier as shown in Figure 4. The lamp capsule itself is the tiny glass envelope in the center of the large white ceramic, dielectric, disc as shown in Figure 5. This lamp—and part of the surrounding dielectric—is enclosed by a faceted coated aluminum reflector (Figs. 6 and 7). The LiFi lamp is not hot-restrike; however, it is very small, so it cools down quickly. In testing, I found it took about one-and-a-half minutes of cool-down before I was able to restrike the lamp, and then five minutes of running to get stable output.

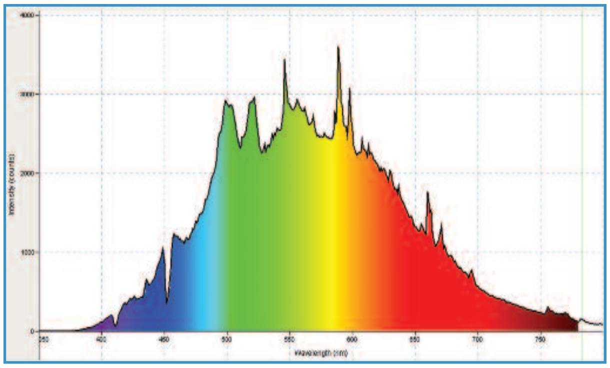

Figure 2: Spectrum at full

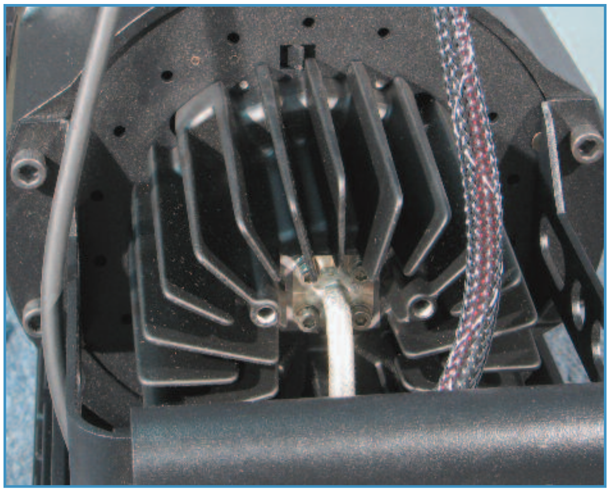

Figure 3: Lamp heat sink

Heat management

As already shown in Figure 3, the LiFi lamp assembly has its own external heat sink. Interestingly, this is all that's specifically provided for the lamp. However, there is a large-diameter fan provided on the rear of the power supply housing, which draws air through the entire unit, including the lamp area, via an internal air-duct connection between the lamp house and power supply enclosure. This fan is thermostatically controlled, and I noticed its speed change as the unit warmed up. During warm-up, immediately after striking the lamp, the output varied noticeably. However, once everything reached thermal equilibrium after about five minutes, the unit was stable in output.

Color mixing

The dichroic color mixing wheels are mounted immediately after the lamp and reflector and before the relay optics (Figure 8). As with the SeaChanger XG, the dichroic wheels are of a very high quality. There are three graded color wheels in the usual cyan, magenta, and yellow, each of which is selectively coated with both a tapered finger pattern of the relevant color and an anti-reflection coating on the clear areas. The advantage of using the anti-reflection coating is that the wheels used in the Nemo don't need to use a hole for the open position. The advantage of a hole is that there is zero light loss; however, the disadvantage is that, where you have a hole, you also have an edge where the hole ends. This edge can often be seen moving across the field as the color fade starts, especially when the colors are as close to the focal plane as they are with the Nemo. The use of AR coating avoids that problem without sacrificing too much light output. The end result is a high-efficiency, low-light-loss, subtractive-color-mix system with very smooth operation. My contacts at SeaChanger tell me they tailored the colors of the three wheels, particularly the magenta, to match the output spectrum of the LiFi lamp and produce the best color range they could.

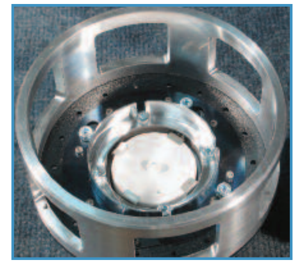

Figure 4 : Lamp assembly

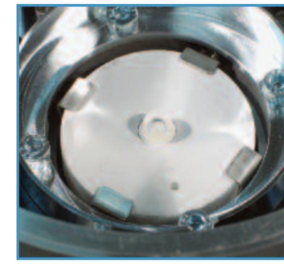

Figure 5 : Lamp capsule

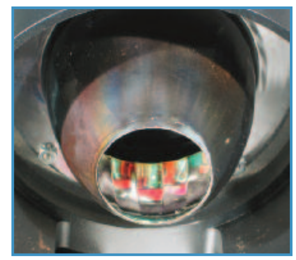

Figure 6: Rear of reflector

Figure 7: Reflector

Figure 8: Color system

Color Mixing

Color	Cyan	Magenta	Yellow	Red	Green	Blue
Transmission	48%	13%	64%	12%	12%	0.6%

As you can see from the output figures, the yellow and cyan are fairly high-output colors while the magenta is more saturated. The mixing results in a very deep blue, which is almost a UV or Congo Blue. In fact, they're so deep that I'm suspicious of the light meter reading. This blue may well fall into that area of the CIE chart where light meters give mis-

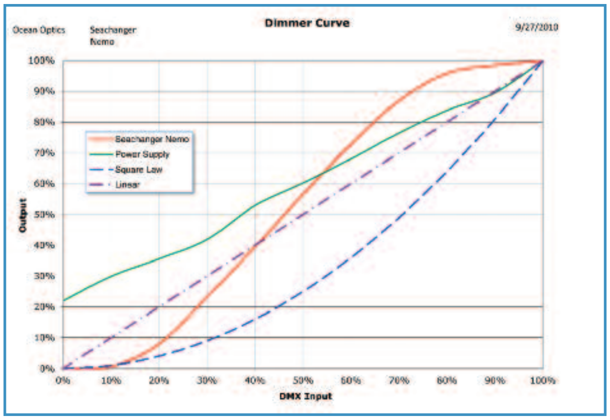

Figure 9: Dimmer curve

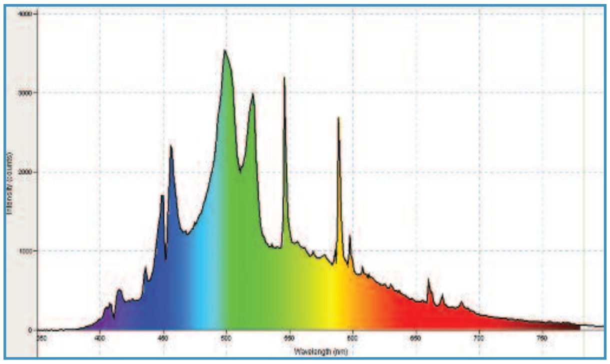

Figure 10: Spectrum at minimum power - normalized

leading results. The mixed red is quite orangey, something that often happens with discharge lamps like the LiFi, which are somewhat lacking in deep red wavelengths. The color-change time between saturated colors is a fairly slow 1.5 – 2 seconds; however, the move is profiled, so the appearance to the eye is slightly quicker than that.

Dimming

Next in line, immediately after the three color mix wheels, is a fourth wheel. In the SeaChanger XG, this is used for the "Extreme Green" wheel. But here, in the Nemo, it is repurposed as a mechanical dimmer. It is still made of glass, like the color-mix wheels, but this time is coated with a graduated pattern in aluminum to provide dimming. Although the LiFi lamp can be dimmed electronically within limits, you need a mechanical dimmer to give a full range and to allow dimming without large changes in color temperature and spectrum. Figure 9 shows the dimmer curve from this mechanical dimmer as the red line. It's more like an "S" law curve than the more typical linear or square law but performs well. Operation was smooth and without artifacts, except at the very bottom of the curve, just as it blacks out the luminaire, when some patterning can be seen. This is no more than in many discharge-source automated luminaires and shouldn't be a problem. More of a problem for me was that the dimmer was quite bouncy in slow fades, particularly over the bottom 20%. In speaking to SeaChanger, this was diagnosed as a loose belt, and I was assured that this problem had been addressed. It's also fairly slow, with a four-second minimum time to black out.

Also visible in Figure 8 is the dim curve from the lamp power supply. Control of the power supply is through a dedicated DMX512 channel, where the lamp power can be reduced from around 300W at full down to about half power, or 150W when the fader is at zero. This equates to a reduction in light output from 100% down to 22%, a very useful amount. However, the user needs to be aware that, as with all discharge lamps (and the LiFi plasma lamp is essentially a discharge lamp under the skin), the spectrum and color temperature change significantly as the lamp is dimmed, the plasma temperature drops, and the heavy-metal salts start to recondense and drop out of the mix. Interestingly, it's always the salts that produce the longer wavelengths that drop out first, so the result is that the lamp spectra becomes reduced in red and thus moves towards the blue as it dims—the opposite of an incandescent lamp. Figure 10 shows the output spectrum when the lamp is fully dimmed down to 150W. Compare that with Figure 2 and you can see that two things have happened; firstly, as already mentioned, the red end of the spectrum is much reduced; but, secondly, the spectrum has become much more spiky and discontinuous. The net result is a significant increase in color temperature—it was too far off the black body line to get a meaningful result but I estimate it is more than 20,000K at minimum dim—and a reduction in color rendering. It also takes the lamp quite a while to settle down and reach equilibrium again whenever this dimmer is changed, particularly when you get below 40%. I would recommend therefore that the power supply dim channel be used as a preset for an entire show and not as a live operational control. If you need reduced light output for the whole show, and can set it and leave it, then it should be a useful control providing energy savings. On the other hand, its live use could cause slightly unpredictable results. Use the mechanical dimmer for your live, operational control.

Optics and output

Next in the optical train are the internal relay lenses, which couple the output from the lamp and reflector into the connected Source Four output optics. This is a complex task, as the coupling must be as efficient as possible while avoiding any imaging of the color mix or dimming wheels. Figure 11 shows the first lens in this multi-lens system. Last in the chain is your choice of Source Four lens barrel. Ocean Thin Films says that you can use any of the Source Four lenses: standard definition, EDLT, or zoom. In this case, I measured the output at a very respectable 7,550 lumens with a field angle of 24° when using the Source Four 26° standard definition lens tube (Fig. 12). With a measured power consumption of 320W, this equates to a fixture wall-plug efficacy of just less than 24lum/W.

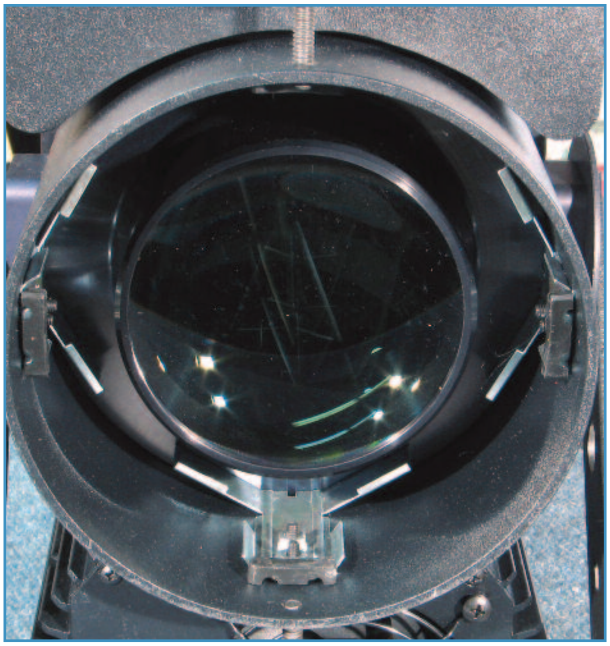

Figure 11: Internal lens

Noise

Not much to report here, as the SeaChanger Nemo makes very little noise! The fan on the power supply is large and slow-moving and the stepper motors are pretty silent. With an ambient noise floor in my test room under 35dBA at 1m, I measured 36dBA at 1m from the stationary luminaire and a maximum of 38dBA at 1m with all motors running.

Electrical parameters

The SeaChanger Nemo is fully power-factor-corrected and auto-ranging (100–240V, 50/60Hz) on both its power supplies (lamp and motor) and consumed 2.7A, 320W, with a power factor of 0.99 when running at full lamp power on a nominal 115V supply. Quiescent power with no lamp running was measured at 36W, 0.48A, and a power factor of 0.65. Initialization time from power up was around five minutes to get a stable constant light output, although you get good light output after about one minute of that. Since I tested the SeaChanger XG three years ago, the company has added remote initialization through DMX512, so the color mix wheels can be re-homed without cycling power.

Electronics and control

The LiFi lamp has a few different requirements to most other lamps; in particular, the connection to it from the power supply is a feed of microwaves through a coaxial waveguide rather than just an electrical current driving an arc. This requires care with shielding and cabling to avoid any leakage. The power enclosure contains the packaged LiFi lamp supply from Luxim, which contains both power supplies and microwave drivers. This is all contained in a sealed box with its own heat sink and connectors, and is visible at the rear of Figure 13 under the reflector. You can

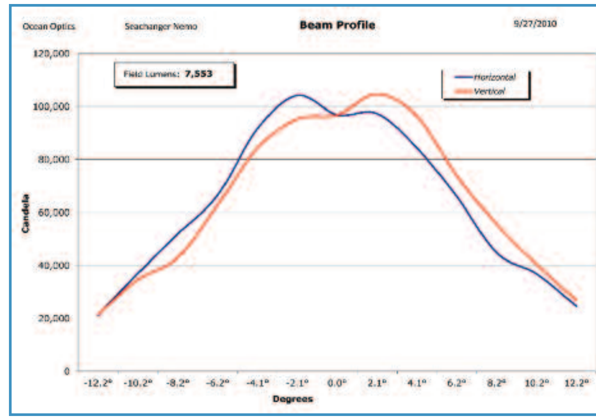

Figure 12: Output

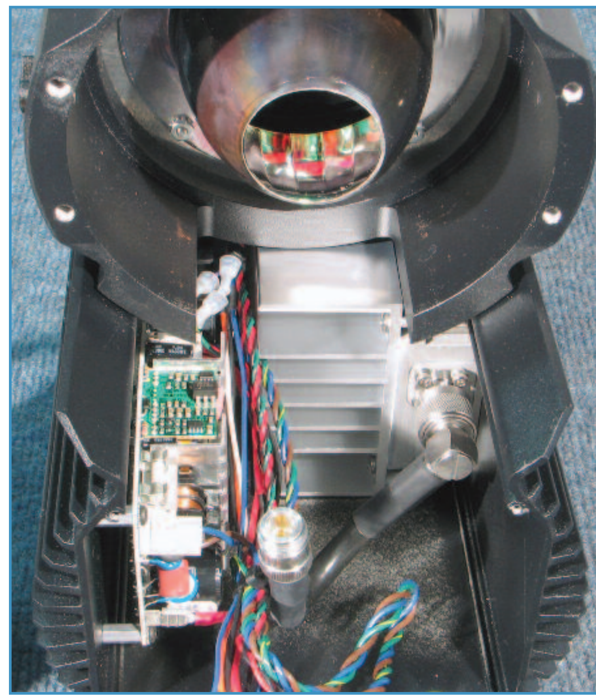

Figure 13: Power supplies

also see in that picture the large coaxial cable, which leads the microwave power to the lamp module itself. On the left of the picture is the conventional low-voltage supply, which drives the control electronics and stepper motors. Those electronics are mounted in the color system module (Fig. 8) along with the stepper motors themselves and a very simple display and controls, which allow setting the DMX512 address and a small selection of self-test and automated running routines (Fig. 14). The DMX512 XLR connectors are also mounted on the color system module, as shown in Figure 15. One enhancement worthy of mention is the addition of full RDM support for the unit. Not only does this provide the expected remote setting for DMX512 address, but also allows the interrogation of many test and operational parameters from the LiFi lamp supply, so you can check if your plasma lamp is running well and be warned of any problems. It's a very sen-

Figure 14: Display

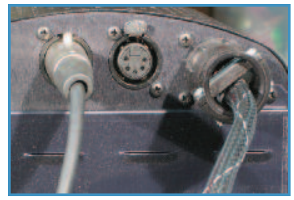

Figure 15: Connectors

Figure 16: Output lens

sible addition for a unit that, with its long life lamp, is firmly targeted at the long-term permanent installation market.

Construction

The construction is very familiar—little has been changed from the original SeaChanger XG—and relies on sheet metal and turned components. Fitting your choice of Source Four lens tube and yoke is a simple process that won't present problems to any competent entertainment electrician. Figure 16 shows a view of the completed assembly with the 26° lens tube. Taking out the color wheels for cleaning is also very simple—just remove four screws and lift it out. As to lamp change, that's also straightforward, although a little more complex than a regular unit; however, if the lamp life lives up to expectations, then it's something you very likely will never have to do!

Conclusions

The SeaChanger Nemo is an interesting concept, a luminaire that provides long lamp life and good-quality color-mixing to the very familiar and ubiquitous Source Four ellipsoidal. The choice of the LiFi plasma lamp is also interesting. It's a light source that is still relatively new and unproven, but which shows great promise if all the life predictions are confirmed. I hope that this review has provided sufficient information and test results for you to decide if the SeaChanger Nemo might be worth investigating further for your application. As always, it's now over to you to make up your own mind.

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