COMMENTS ON THE PRIORITISATION OF NMP FOR ANNEX XIV

Space Sector Contribution to the Call for information (on behalf of the Commission) on the possible socio-economic consequences of the authorisation requirement for NMP

This is the joint contribution of the European Space Industry, represented by ASD-Eurospace – with the support of European and national space agencies – to the call for information (on behalf of the Commission) on the possible socio-economic consequences of the authorisation requirement for 1-Methyl-2-pyrrolidone (NMP), EC number 212-828-1.[1] The contribution was elaborated in co-ordination with the EU battery manufacturer Saft, to complement the comments submitted by Saft to the same call for information.

Introduction:

NMP is used as a solvent in the production of the positive electrode within Li-ion batteries that are qualified for use on European space launchers and vehicles. The space sector is the end user of this battery technology, which represents the forefront of rechargeable battery technology in terms of energy density and lifetime. These batteries are used universally within space applications and are critical to the success of the European space sector, as they provide the primary power storage solution for launchers and space vehicles:

In launchers:

- Li-ion batteries are used as a source of power when the external power feed is removed and also on each launcher stage.[2]

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[1] The contribution has been prepared in the frame of the Materials and Processes Technology Board of the European Space Components Coordination (ESCC MPTB). The ESCC MPTB is a partnership between the European Space Agency (ESA), national space agencies, and space industry represented by Eurospace, chaired at present by ESA. Current participants from Eurospace include: Airbus Defence & Space, Airbus Safran Launchers, Avio, MT Aerospace, OHB, RUAG, TESAT and Thales Alenia Space. Participating national space agencies are: Agenzia Spaziale Italiana (ASI), Centre National d'Etudes Spatiales (CNES) and Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR). Other participants are MAP, a manufacturer of mixtures, and REACHLaw, a consultancy supporting the group on REACH and other chemical regulations.

[2] For example: Actuator and Telemetry Battery to power the electrical motors of the Thrust Vector Control (TVC) actuators of the 4th stage of the launcher (AVUM) and the master telemetry unit (UCTM); On Board Battery (OBB) to provide the Guidance, Navigation and Control Subsystem (GNC) with the required electrical energy; Thrust Vector Control (TVC) batteries to supply the electrical motors of the TVC actuators of the three stages of the VEGA launcher.

In space vehicles:

- Batteries are required during an eclipse[3] and when the vehicle is in shadow with no electrical power being generated from the solar panels. Batteries power the systems during these phases and are then recharged from the solar panels after the eclipse.

During Interplanetary Transit missions:

- These often have irregular eclipse schedules and require batteries to manage the power load for extended eclipse periods.

In Planetary Lander and exploration missions:

- Batteries are required to power missions during planetary night phases and to ensure adequate wake up power

In addition, Li-ion batteries are required to manage eclipse period power loads and peak power loads on the International Space Station (ISS).

The batteries must work reliably and with minimum degradation and be capable across the strenuous mission demands over the whole lifetime of the launcher and space vehicle. In all instances, launchers and space vehicles, it is necessary to ensure that a source of lightweight electrical energy storage is available.

Batteries are critical systems for the space sector; if the battery fails the mission will fail. The Li-ion batteries, currently supplied in Europe by Saft, fulfil all the current requirements and needs of the sector.

This battery technology has been used in European[4] and international space applications for more than 15 years and all current, and planned, launcher and space vehicle projects rely on it alone for their energy storage needs. It is the only technology that is currently able to be used for the applications for which it is employed. This is for several reasons:

1. Size and Weight: Li-ion batteries a currently lighter and smaller than alternative battery technologies. Within the space sector, size and weight considerations are of paramount importance, as the heavier and larger the battery packs significantly decreases the viability around the cost of space missions. For critical parts, change of design can have impacts on

[3] Eclipses can occur up to 5000 times per year, depending on the space vehicle's orbit.

[4] Some examples of forthcoming European space vehicles reliant on Li-ion battery technology are Taranis (launch date 2018); CSO (launch date 2018); Merlin (launch date 2019); Microcarb (launch date 2020); SWOT (launch date 2020); CERES (launch date 2020). A representative list of ESA Projects that Li-ion has flown on (or is about to) includes: Bepi Colombo (Mercury Exploration mission), Cheops (Exo planet observer), Earthcare (Earth climate observation), EDRS (Telecoms satellite), EXOmars Trace gas orbiter (Mars observation and sampling satellite), Metosat (weather observation satellite), Sentinel (Earth climate observation) and Galileo (Satellite Navigation).

the global mass balance and therefore on global performance of the launcher or space vehicle.[5]

2. Energy density of Li-ion batteries is about 2x higher than an equivalent Ni-H_2 battery, which was the previous technology used in space vehicles. This means that for the same energy storage requirements, Ni-H_2 batteries would be twice as heavy. Reverting to Ni-H_2 technology is thus not feasible, since all space vehicles are designed taking into account the low mass associated with Li-ion technology. Furthermore, Ni-H_2 or Ni-Cd technologies have now been abandoned in space applications.
3. No other battery technology has demonstrated sufficient maturity to be safely implemented in replacement of Li-ion in space applications.
4. New technologies in the space sector require the building-up of Heritage, which involves using the experience of parts and technologies from previous missions to give credibility and confidence in the performance of this technology for future missions. This consideration cannot be underestimated, especially for satellites that rely on the battery technology to function properly over the course of many years (decades).
5. It took many years of development and qualification testing to demonstrate that the current manufacturing process of Li-ion positive electrodes, using NMP, gives the high level of robustness, consistency and reproducibility required by the space industry. Modifying this process, by replacing this solvent, would require huge amount of investment and work to reach the same level of confidence.

Li-ion batteries are the best compromise between cost, weight, and performance.

As Li-ion batteries are currently the only viable technology for these applications within the space sector, their use is a necessity. Changing from this technology is not possible.

The current EU manufacturer of these batteries, qualified for use in launchers and space vehicles utilises NMP in its manufacturing process. It is not present in the final battery and, therefore, there is no potential exposure to workers in the space sector due to the use of this technology.

The requirements of the battery differ between launchers and space vehicles. For launchers the battery is required for approximately 5-6 hrs of use, whereas for space vehicles (satellites, interplanetary transit missions, landers, etc.) the requirements are far higher and the battery can be in constant use for up to 15 years. The current, qualified battery supplier manufactures batteries that are suitable for all space applications.

[5] Recently the International Space Station started replacing its legacy Ni-H_2 batteries with Li-ion batteries. The original 48 Ni-H_2 batteries will be replaced with 24 Li-ion batteries; On top of this, the individual Li-ion batteries are half the size of the individual Ni-H_2 modules representing further volume and weight saving.

Nevertheless, as the requirements of launchers and space vehicles differ, the options available are also different.

An option could potentially exist that Li-ion batteries, manufactured using a process not requiring NMP, are sourced, in the future, from within the EEA, for launcher applications. This manufacturer (EAS Germany GmbH) is not currently qualified to supply batteries for European launchers, however, they have been used in Russian launchers and will soon be used in Indian launchers. Though moving to batteries manufactured without NMP may be possible for launchers, such a shift would require time, money and work to reach the same level of confidence as the current qualified process.

Batteries manufactured with this alternative process have not, however, been used, or qualified for use, in space vehicles; either inside or outside of the EEA. As noted previously, the demands on the battery by space vehicles is far higher than that of launchers. It is not known if the alternative manufacturing process provides batteries that are suitable for these demands as the main reason for use of NMP is that it results in batteries with longer lifespans. Furthermore, there would be a need to qualify this new process over the entire lifetime of the space vehicle and establish its heritage.

As no NMP is present in the final battery, and as qualification of non-EEA manufacturers that use the NMP process as suppliers is quicker, cheaper and easier, giving batteries with proven heritage, importation of batteries into the EEA is a possibility for the space sector, especially those companies involved with space vehicles. Consequently, inclusion of NMP on Annex XIV for this use could result in considerable supply chain restructuring to source Li-ion batteries from outside of the EEA, promoting the manufacturing of Li-ion cells and batteries in non-REACH regulated territories, while impairing innovation within the European battery industry. This is seen as the likely non-use scenario for the space sector should NMP be included on Annex XIV as there are already qualified suppliers of Li-ion cells for space applications in Japan, Taiwan and in the USA.

Furthermore, sourcing of technologies for the space sector outside of the EEA is against the spirit of the EU's policy for non-dependence in space technology.[6] Accordingly, such a strategy would be in contradiction to both the European Space strategy, which is to maintain European autonomy for these strategic components; and for the development of the e-mobility sector in Europe, development that the European Commission supports. The ESA Convention further provides for strict regulations regarding the location of production facilities of all ESA suppliers. A major consequence of this rule is that all of the assembly and integration activities for ESA programmes have to take place within Europe. Outsourcing this technology from the EEA would, in addition, have an impact on the key goal of maintaining Europe's independent access to space.

[6] "The survival of a competitive commercial industry in the space sector in Europe and thecapability for European institutional customers to implement their missions require a decrease in European technical dependence on non-European countries[…]" Source: Communication of the EC on EU space Industrial Policy-Releasing the potential for economic growth in the space sector, February 2013 - COM(2013) 108 final - reaffirmed in the May 2017 EU Council Conclusions on "A Space Strategy for Europe" (Resolution 13).

Such goals of space independence are not unique to the EU, with the US government heavily subsidising private companies to develop a fully vertical supply chain of Li-ion cells for space applications located solely in the USA; starting from the raw material for the electrodes. Their aim is to create a secure domestic source of materials and cells for US government space applications.

Authorisation:

The aim of Authorisation to ensure the good functioning of the internal market while assuring that the risks from substances of very high concern are properly controlled and that these substances are progressively replaced by suitable alternative substances or technologies where these are economically and technically viable would not be fulfilled by the inclusion of NMP on Annex XIV for the use in battery technologies used by the space sector.

This is because:

1. The inclusion of NMP on Annex XIV would indicate that it should be progressively replaced by suitable alternative substances or technologies. No alternative, qualified substances or technologies exist, nor will they exist in the medium to long term, for this use for the companies qualified in the space supply chain. As noted previously, an alternative, non-qualified process could potentially be qualified and implemented for launchers in the future, though this will still take some time.
2. Given the above, time-limited Review Periods do not provide workers in the European space sector or the environment with any additional regulatory protections over and above that which the proposed Restriction could provide.
3. The process of applying for Authorisation to prove safe use via a risk assessment (adequate control) or socio-economic arguments for continued use of NMP is also inappropriate given that no viable qualified alternative technologies or processes currently exist for the entire space sector. Inclusion of NMP on Annex XIV would, therefore, impose on this sector, and the battery manufacturer as the supplier, unnecessary administrative and financial burdens while introducing needless uncertainty to the supply chains.
4. Inclusion of NMP on Annex XIV for this use will, in addition, add to the administrative burden of the ECHA, EC and Member States given the lack of alternative substances or technologies covering all European space applications.
5. The risks from the use of the substance can best be controlled using the proposed DNEL from RAC as well as a commitment by battery manufacturers to ensure relevant hierarchy of controls are in place to reduce potential exposure.
6. As no alternatives for this use exist, and the technology is critical to space applications, there may be a requirement to import the batteries

from outside of the EEA. This, in our opinion, does not correlate with ensuring good functioning of the internal market and could risk the loss of technical capabilities for battery development within the EEA. Furthermore, any potential risks in using the substance are being exported to outside of the EEA.

SEAC conclude that Authorisation of NMP might be effective and practical for some sectors. Based on the arguments provided above this is not the case for qualified battery suppliers to the European space sector.

Restriction:

Restriction with worker protections would, according to the battery manufacturer, seem to be a more pragmatic and suitable RMO. The end-user space sector supports this viewpoint.

CONCLUSION:

Currently the EEA maintains a leadership position for Li-ion space technology. The European technology has a unique flight legacy in terms of time in market and flight hours, but also a specific technical competency. NMP-free Li-ion production in Europe is limited today to a small field of applications. The strategic loss of European competence in Li-ion space cells would have a tangible effect on technical competence in the European space sector and R&D efforts targeted on European space needs.

Given the need, therefore, for Li-ion batteries for space applications and for a long term secured supply, as well as the already proposed Restriction of NMP under Annex XVII following its identification as the best RMO, we believe that Annex XIV inclusion of NMP would not be an appropriate regulatory option at this stage.

Should NMP be placed on Annex XIV, several long review periods could be required for the sector as no alternative, qualified processes or technologies exist in the EEA to manufacture the batteries to a standard required for all space applications, while introducing uncertainty into the supply chain. The aim of replacement of the substance is, therefore, not enhanced through Authorisation. As a consequence, and in order to minimise the burden on the space sector, EEA battery manufacturers supplying to it, and the authorities; Restriction, as proposed by the Netherlands and amended by the RAC and SEAC Committees, is the most proportional response to mitigate the potential risks of using NMP.