Left to right: Bob Willis, SMART group; Nigel Burtt, Dolby Labs: EMP's Dave Tudor; Chris Hunt, NPL; Neil Stanton, BSI (unable to participate); Alan Lund, RS Components

A pause for reflection

It feels like it's been around forever, but the July 1st deadline for RoHS, also known as Directive 2002/95/EC, is now within touching distance.

So how are things progressing? As the bell rings for the final lap and the finishing tape looms ever nearer, EMP's Dave Tudor rounds up industry experts Alan Lund of RS Components, Nigel Burtt of Dolby Labs, Bob Willis of the SMART Group, Chris Hunt of NPL and Nick Hoo of Soldertec, for a question and answer session.

Q *As we reach the crescendo of RoHS mania, with the deadline of 1st July 2006 just around the corner, it's sometimes easy to forget that the reason for its formulation was to protect the environment against the accumulation of hazardous wastes resulting from consumer products. Do you believe that the directive in its purest sense, was necessary?*

A

Nigel Burtt: I believe the heart of the WEEE and RoHS directives is in the right place. We live in a throwaway society and the increasing mass of waste electronics going into landfill is unsustainable on both a national and global scale.

Nick Hoo: As I'm not an expert on environmental risk assessment, I have to trust those people knowledgeable in the field. If such people decide that the RoHS substances must be removed from use, the only mechanism that would achieve effectively is via legislation as voluntary measures are unlikely to have been adopted widely.

Alan Lund: While the environmental concerns are to be applauded, if electronic equipment was properly recycled and not sent in large amounts to landfill, such measures would probably not be necessary.

Chris Hunt: It's arguable whether the RoHS legislation will greatly help the environment, but NPL has made every effort to inform and practically assist our industry to meet the challenges that this legislation has posed.

Q *The directive has been around for several years now. Do you think in general industry has taken RoHS seriously enough or is it a case of 'too much to do, too late?'*

A

Nigel Burtt: I think too many people woke up to the detail, and hence to the real impact, much too late. I feel industry as a whole should have been ready to respond earlier and make the inevitable requirements more realistic to implement.

Nick Hoo: A large proportion of the industry has not treated the RoHS directive with the seriousness and urgency required. In many cases, the full implications of the directive have not been identified and the scale of the issues seriously underestimated.

Alan Lund: Initially industry was unsure about the potential implications of RoHS. The directive takes its scope from the WEEE directive and concerns finished goods so initial interest was from manufacturers of equipment clearly within scope of WEEE. The component manufacturers and component distribution industries subsequently realised that in order to build compliant equipment, 'compliant' components were required. The RoHS compliance status of electronic and electrical components, mechanical items such as fasteners and fixings, cable ties and even labels attached to products also needs to be considered.

Chris Hunt: NPL has carried out countless studies and organised presentations of our work, specifically on lead-free for over 10 years. Our part government funded centre has not questioned the legislation, but has been tasked to help industry meet its requirements.

Q *Do you think that the requirements of the directive are clearly defined? If not, what in your opinion could have been done to improve the situation?*

A

Nigel Burtt: The requirements are still not well defined with too many grey areas and differences in implementation and policing already noted in different member states, which is not supposed to happen with a single market directive like RoHS. The most damning example was the actual definition of the permitted levels of six restricted substances and how these were to be measured – the so called 'homogeneous material definition.' For this EU decision only to be made formal on the 18th August 2005, less than 12 months before the RoHS deadline, is really pretty scandalous. The definition of 'put on the market' should also have been explained better.

Bob Willis: No, the definitions of products that are exempt are not clear. Better specific product examples or photos would have been helpful to make interpretation easier.

Nick Hoo: The basic requirements of the directive have been known for many years, though industry has clearly focused on lead-free soldering. For the most part the directive is fairly clear, but one of the biggest problem areas is the exemption status of industry sectors, applications, and processes and materials for which there is no viable replacement. This activity should have been started and completed, at an earlier date.

Alan Lund: The requirements of the directive were not initially obvious and it was clear that there was a need for further guidance as to the actual scope. The current advice is that unless an item is specifically excluded from the requirements of the directive, it should be considered as included.

Chris Hunt: The communications from DTI have been comprehensive to the extent that the requirements of the directive should now be clear and defined.

Q *In your opinion and experience, what has the industry had most problems with in the pursuit of compliance with the directive?*

A

Nigel Burtt: Confirmed availability of lead-free components initially to set up our new processes was a huge problem. Then to go further and have confirmed RoHS-compliant parts seemed to be another enormous step. There are still many parts where availability is poor due to extended lead-times which is impeding our progress towards full compliance. Without the purchasing clout of a large multinational manufacturing organisation behind you, some suppliers still don't react fast enough and notice of the lack of availability often comes too late to design the offending part out.

Nick Hoo: The biggest single problem has been sourcing a complete range of RoHS-compliant components, parts and materials for R&D and production.

Alan Lund: Component availability and understanding of the requirements have been the most challenging issues in pursuit of compliance.

Chris Hunt: The initial question was whether the alternatives would work and be reliable. Today that has given over to more pragmatic considerations as shown by the most recent SMART Group poll that listed the following as critical: availability of lead-free components, various compliance issues, cost of stock to support spares, the time in transitioning to lead-free, reliability, moisture sensitive devices, rework and repair.

Q *The use of nitrogen in a lead-free wave or reflow soldering process is claimed to offer benefits such as improved wetting and pad coverage, improved joint profiles, dross reduction and reduced soldering temperatures. The UK seems very slow to embrace the technology. What do you feel the reasons are for this and can you see the use of nitrogen, used as a convection medium, gaining popularity as time goes on?*

A

Nigel Burtt: My opinion is that nitrogen of sufficient purity and at volume flow rates needed to make a difference to wave and reflow, is too expensive to provide and maintain. In my experience, most people are finding the soldering results with lead-free are not that different than tin/lead and if you don't already use nitrogen in your processes you don't need to add it for lead-free.

Bob Willis: We know that nitrogen provides benefits to the manufacturing process but many people are reluctant to use it based on cost.

Nick Hoo: For many products, satisfactory lead-free manufacturing is possible without the need for nitrogen. The use of nitrogen can improve processes and have other spin-off benefits and some problematic assemblies may require the use of nitrogen. As the drive to miniaturisation and more complex component-types continues, the need for nitrogen may increase.

Chris Hunt: There is no question that the only drawback to using nitrogen is the added cost but our combined studies with BOC showed definite benefits can be achieved, but changes in flux design make this a moving target which may obviate the need for nitrogen. Flux residues from more active fluxes and the effect on long-term reliability remain an outstanding issue. It can be argued that local generators, instead of the large tank in the car park would be much more price competitive making nitrogen more attractive.

Q *Regarding lead-free solder, much research and testing has been carried out to establish its performance in comparison with tin/lead solder. How does it shape up with regard to performance and reliability?*

A

Nigel Burtt: Our tests so far have shown that the lead-free solder joints we are making are as good, if not better, in terms of mechanical strength and reliability than tin/lead, for our product within its normal application and operating environment.

Nick Hoo: The performance and quality of lead-free soldered products is determined by a number of factors, so it is impossible to say categorically that one solder is better than another in all instances. One major factor though is manufacturing quality and process optimisation and it's interesting to note that many companies who have developed lead-free processes have also improved the quality and yields of their current tin/lead production after applying the lessons they learnt.

Chris Hunt: Our work has shown that there are small differences with lead-free alloys, and in many circumstances the lead-free alloys outperform traditional tin/lead alloys.

RoHS & lead-free production

Q *The RoHS directive states that from July 1st 2006, all electrical and electronic equipment produced in the EU will be subject to the restricted use of six substances: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE). The focus however tends to be on lead, with the other banned substances potentially being overlooked. Do you see this being a problem?*

A

Nigel Burtt: I think most people are now aware that RoHS is much more than just about lead-free soldering. Whether companies have the resources or the desire to really fully understand where the restricted substances might occur in the components that make up their products is another matter.

Nick Hoo: The focus on lead-free, and lead-free soldering in particular, has been detrimental as it has overshadowed the prohibition of the other substances. However, an increasing number of events, including the IPC/Soldertec conference in Malmo, are including papers dealing with substitution and management of the other RoHS substances.

Alan Lund: Out of the six restricted substances, lead is most frequently encountered in electronic and electrical products, hence the emphasis. Lead and cadmium are generally thought of in their metallic forms and not everyone realises that cadmium can also be found in plastics. Hexavalent chromium is often confused with chromium metal and there has been conflicting advice as to whether certain passivation coatings are actually RoHS compliant or not, especially when coupled with the definition of the Maximum Concentration Values (MCVs). PBB and PBDE are particularly difficult to identify without resorting to complex chemical analysis techniques.

Chris Hunt: It can be said that RoHS is viewed as the banning of lead, as this probably represents the biggest challenge, but NPL and Soldertec/Tin Technology are well aware of the six substances, so really the industry should be aware too.

Q *The exemption areas of the directive means that many CEMs have to run dual manufacturing lines, leaded and unleaded. How do you see the availability of leaded components and lead-free components affecting supply as we approach and go beyond the deadline date?*

A

Nigel Burtt: The component suppliers' situation is no different from electronics product manufacturers. No one really wants to have to provide both leaded and non-leaded products simultaneously and the inevitable course for the supply chain should be that leaded parts become more expensive and harder to obtain and lead-free/RoHS parts become the norm and thus cheaper and more readily available. This must have an impact on those industries that still want to use leaded components after the deadline as unlike the rest of us, they're going to need to be looking for documented evidence of non-compliance.

Bob Willis: From the very start the biggest problem has been components. All the standard passive and simple active components have been lead-free for years but it's the main active parts that are an issue. Many companies will find that parts are just made obsolete, putting many designs at risk with no time to find alternatives or modify the designs.

Nick Hoo: There is no doubt that a need for leaded and lead-free components will complicate the supply chain more than it already is. It should be remembered that historically, many components were supplied as lead-free in any case and these were used in processes using tin/lead solders.

Alan Lund: Experience to date would suggest that many component manufacturers will eventually supply one version of a given component driven by market requirements, with suppliers that are servicing the consumer equipment manufacturing market among the first to convert.

Chris Hunt: In our long-term view it seems likely that all production will go lead-free due to the inevitable lack of leaded components. In the short term it will be the large CEMs that will be able to afford the two separate production lines.

Q *Are there any performance implications associated with the use of lead-free solder with leaded components?*

A

Nigel Burtt: The NPL study showed that mixing lead and lead-free solder and components appeared to have no risk, with the exception of BGAs and these findings agree with our own tests. Leaded BGAs with lead-free paste may not survive the higher reflow temperatures needed and lead-free BGAs with tin/lead paste may suffer from poor alignment and poor metallic structure within the balls. The latter can be solved if it is possible to run the tin/lead paste reflow peak hotter by 10-15°C, ensuring that the lead-free balls do melt – but this obviously depends on the rest of the components that make up the assembly being able to survive a higher peak temperature.

Soldertec's Nick Hoo

Chris Hunt: Recent NPL study results showed the reliability of the solder was not affected by contamination by lead. It did show that there is a latent problem with double sided assembly where temperatures above 183°C may result in component detachment. A further finding revealed how the process window collapses when lead is removed, indicating that the impact on process yield and field returns is likely to be significant.

Nick Hoo: There are no obvious reasons why leaded components could not be soldered using lead-free solders. Components with lead-containing coatings or surfaces should be solderable, and will be wet by and react with lead-free solders. The main incompatibility concern identified is mixing bismuth and lead, as low melting point phases might be formed. However, dilution due to mixing during soldering should prevent this from happening.

Bob Willis: Generally the solder joints are equal to or stronger than tin/lead. In most applications this is the case, but in high loading, shock or bump testing, the less ductile tin/silver/copper can give issues. However there is a lot we still don't know about lead-free and we will just have to learn quickly.

Q *The burden of complying with the RoHS directive falls upon producers, and it needs to be demonstrable, via an effective documentation audit trail. The task of policing this has been tasked to the National Weights and Measures Laboratory (NWML). How difficult a job do you think this will be for the industry and NWML?*

A

Nigel Burtt: Providing a documentation trail is becoming progressively easier as more and more component suppliers realise what they need to provide their customers. The NWML still has an unenviable task since proving compliance beyond the documentary evidence requires complicated analytical scientific techniques, the results of which could be disputed and thus we have a legal minefield. They have said, its aim is to aid the path to compliance and not pursuing accidental transgressions and only those who fail to comply though deliberate lack of action or wilful negligence need worry.

Bob Willis: Its has to be a working partnership with no big stick if there are issues to be resolved over compliance. These need to be worked through for the good of the industry.

Nick Hoo: Maintaining an audit trail will be time-consuming and could be difficult to establish if a producer has a large number of suppliers in different geographical regions. Certification documentation also does not guarantee compliance. The ramifications of the failure of a 'certified' part are still to be resolved and may not be clear until it has occurred. NWML has not yet revealed detailed information of how the directive will be policed and it's clear that many European countries are watching the situation in the UK for guidance.

Alan Lund: Producers and the regulators will primarily have to rely on an effective audit trail, as testing tens of thousands of individual products consisting of many thousands of components and homogeneous materials will prove to be impossible and extremely costly for even a single item.

Chris Hunt: There is bound to be a learning curve from July 1st, but NWML has taken its responsibilities seriously. They have gone out on the road to help advise our industry and we know that they are liasing with other enforcers in Europe. It's not an easy task but we are confident that they are more than able to meet the challenge.

Q *Although an EU directive, are you seeing evidence that the rest of the world is aware of the directive and taking action?*

A

Nigel Burtt: Clearly what is happening with China's version of the RoHS and WEEE directives is of serious concern and I would hope that the DTI are keeping abreast of this and lobbying on behalf of UK electronics manufacturers to make sure that their laws do not go too far beyond what is required in the EU. That said, since the bulk of modern electronics manufacture takes place in China and is exported, it is somewhat reassuring that they are taking this seriously too.

Nick Hoo: On the whole, awareness in the rest of the world is quite high and there's a realisation that the electronics industry relies on global supply chains and sells to global markets. Therefore awareness of RoHS is necessary at some level.

Alan Lund: The rest of the world is taking an active interest in the developments in Europe. Although RoHS does not have a legal basis outside of the EU there is much evidence to suggest that it is becoming an important purchasing consideration elsewhere.

Chris Hunt: As a part DTI funded organisation it's true to say that we have concentrated mainly on the UK, but through our field of global contacts we can see that the rest of the world is also facing up to this challenge.

Q *Nearly done now. The million-dollar question. Will the industry be ready come July 1st?*

A

Nigel Burtt: I suspect the vast majority of small-to-medium manufacturers in the EU and the import agents for similar sized organisations based outside the EU will not be 100 per cent ready.

Bob Willis: The majority of companies will not be ready in time and those that are may be faced with subsequent processing issues that were not originally obvious.

Nick Hoo: Some will be. Many won't.

Alan Lund: Indications are that the industry as a whole is well down the route to compliance but there are potentially many reasons why not everyone will be ready, including component availability, conversion of manufacturing facilities, proving new designs etc.

Chris Hunt: The larger companies will no doubt be ready, as will the smaller RoHS-aware operations. But, there will also be those companies that have left things too late.

Q *Finally, if you had a RoHS-compliant magic wand, what would you change to make the UK a happier place?*

A

Nigel Burtt: It's clear from reading the directive that magic wands are outside the scope of RoHS.

Bob Willis: Make the legislation much clearer. Unfortunately the interpretation has been confusing.

Nick Hoo: I think I would create a large market-based demand for RoHS-compliant products to encourage and spur UK manufacturers through the transition.

Alan Lund: Recycling of electronic and electrical equipment should remain a priority. Repair and re-use is far preferable to burying products in landfill.

Chris Hunt: It's too late now, but in the early stages of transition some form of financial assistance would not only have been useful but it would have encouraged industry to respond quicker.