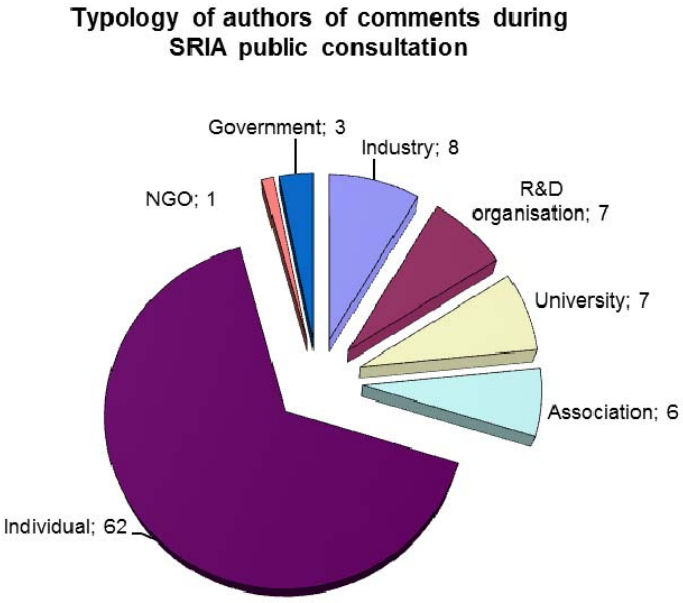
Strategic Research and Innovation Agenda (SRA)

Results of the public consultation
(17 Dec – 10 January 2013)

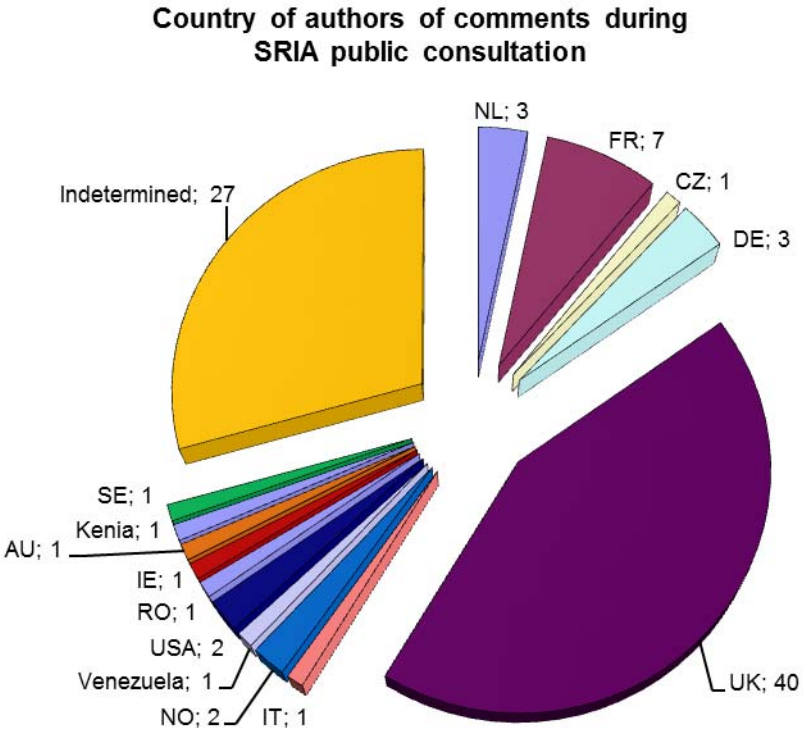
Comments received on the
SRIA Executive Summary and Main Document
and answers provided by the SRIA Editorial Board

Summary of comments and answers

Comments have been received from 94 authors. The typology is given in the chart below.



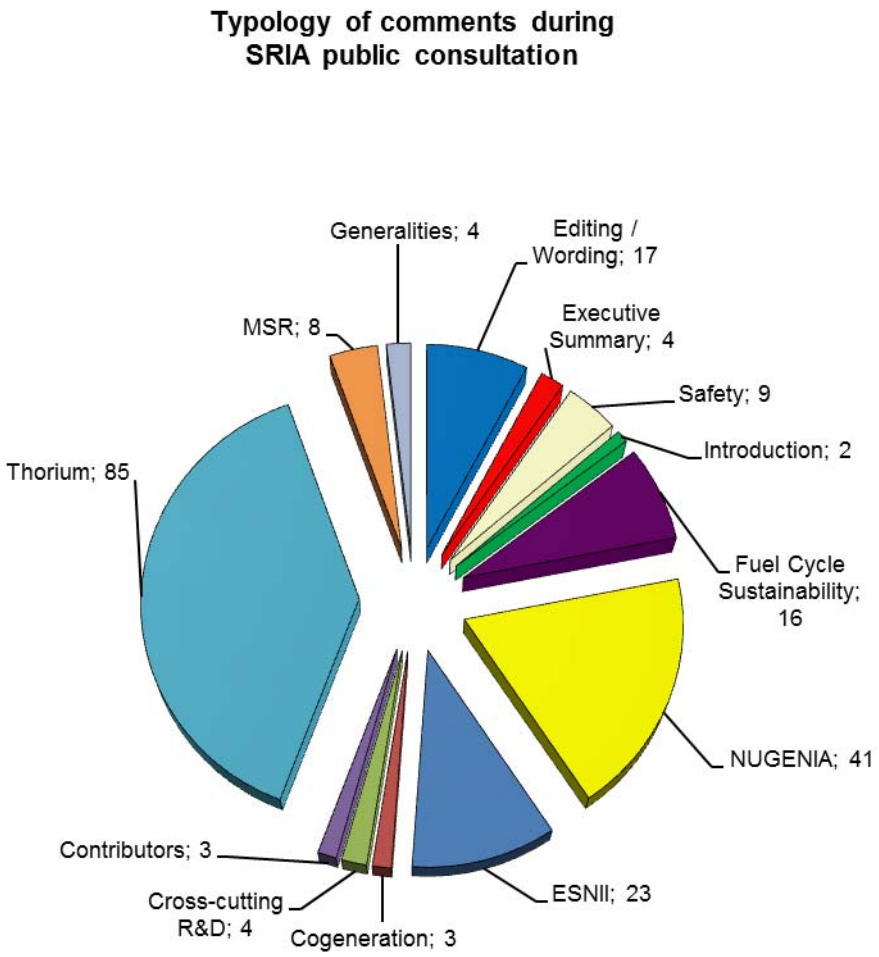
The country of origin of the authors of the comments is reflected below:



The comments have been sorted in the following pages according to the date of reception. The SRIA Public Consultation has received 94 comments. As they sometimes address several topics, they have been divided to address only one topic per comment. As a result, 219 individual comments were identified in the revision of the SRA. Out of these, 76 were taken into account, resulting in a **ratio of 35%**. This ratio is broken down by topic as follows:

	Number of comments	Positive answers	Ratio
Editing / Wording	17	17	100%
Executive Summary	4	4	100%
Safety	9	3	33%
Introduction	2	2	100%
Fuel Cycle Sustainability	16	7	43%
NUGENIA	41	27	66%
ESNII	23	11	50%
Cogeneration	3	1	33%
Cross-cutting R&D	4	2	50%
Contributors	3	1	33%
Thorium	85	-	(1)
MSR	8	-	(1)
Generalities (1)	4	1	25%
Total	**219**	**76**	**35%**

And can be analysed in the following pie chart:



(1) Precisions:

- The 'Generalities' topic includes such issues as: scope of the SRIA, lack of prioritization, funding, etc.
- Many comments were received about the **Thorium fuel cycle and Molten Salt Reactors**; a clarification on SNETP position on Thorium and MSR research is available on annex of this document. It has been created by the Editorial Board to answer globally to all comments related to Thorium and MSR.

Finally, as a general comment, the SRIA did not evolve much after the public consultation phase, because it already resulted from an intensive work of many representatives of the European nuclear community.

Complete list of comments
and answers provided by the SRIA Editorial Board

Legend:
- Comments are sorted by topic (generalities, then SRIA chapters)
- The basis for the answer by the SRIA Editorial Board appears in blue

General comments (most are for the SRA Main Document)

1.

Comments are based on the latest SRIA version sent for public consultation
Addition of comments or correction are indicated in red characters

EXECUTIVE SUMMARY

- Page 7: "a double strat reactor fleet. The first stratum is a set of critical reactors dedicated to …… The reactor is this stratum can be either present or future thermal reactors or fast reactors, or an appropriate combination of both generations

Accepted

- Page 11 : NUGENIA technical area 6

Knowing that new technology development at the industrial scale could be a long term duration process, the following time lines will be considered

- Evolutionnary technology for mid term application
- Breakthrough technology for a longer term future
- Advanced LWR designs such as with higher conversion ratio or small modular reactors, expected to be ready for commercial operation by 15 to 20 years.

Accepted

INTRODUCTION

- Page 19:

The security of supply will be assured for thousands of years when considering future fast neutron reactors with closed fuel cycle through recycling of uranium and plutonium.

Partially accepted

- Page 20: The second chapter addresses the R&D challenges to further improve the current fuel cycles. The current reactors are only able to use 2% (to be clarified Of all the resources available, only 2% are useable by today's reactor park. Today's reactor park only uses up to 2% of the uranium resources to make energy.The latter 2% to be compared with the typical value of 0,5 à 0,6 CR for LWRs.) of the uranium available in nature. To enhance the use of uranium and minimisation of the final waste the closed fuel cycle and advanced neutron reactors play a vital role. The chapter identifies some R&D measures to optimise natural resources use in the short term.

Partially accepted

SUSTAINABILITY OF THE NUCLEAR FUEL CYCLE

Introduction
Page 26: Sustainability of the nuclear fuel cycle is developed over three basic pillars: waste minimization, resource optimization and improved economic competitivenessWhat about human and environmental impact minimisation (e.g. radioprotection to workers (or being considered safety?), other than HLW-arising which is typically udenrstood by 'waste minimization', and socio-political aspects as non-proliferation?)
. ……..Besides, this could provide a very large reduction of

Referring to an old version, in the actual version already changed

Page 26: The change to this future enhanced sustainability will be, most probably, a long progressive process that has already started and that will demand a progressive deployment ensuring deployment of proven technologies while minimizing the industrial and thus economic, safety and environmental risks. Indeed some of the technologies for recycling fuels

Partially accepted

Chapter 3
Chapter 3.1
Page 27: . Consequently, SRIA in this area should focus on enhancing the usage of mined uranium and generated plutonium in the present and future reactors, and the NFC back end option(What about improved knowledge on new extraction methods reducing the environmental impact of U/Th-mining and ways of performing, f.i., environmental remediation. Is this out of SRIA?)

Out of scope

At short and medium term: Scenario Studies of nuclear materials management issues at the European level on the evolution of nuclear reactor fleet, including uranium and plutonium availability with consideration to the timing of deployment of FNRs

Referring to an old version

Chap 3.2
Page 29: Once the waste has been produced, if the spent fuel is directly disposed of, there is in fact no way to act on the previously indicated optimization parameters, except the enhancement of confinement properties and its durability (waste matrix or waste container) and the time before disposing of the NW. This research could also contribute to reduce the "long term radiological

Accepted

page 29: If the spent fuel is reprocessed, many technical options are open to bring improvements in the five NW parameters quoted above.
Proposal to add: Today's experience in Europe in reprocessing spent fuel and recycling uranium and plutonium is already a first though very important step towards waste minimization. As most of the toxicity of spent fuel stems from Plutonium, Pu-management in today's and future nuclear reactor parks is already a crucial and decisive step towards such waste minimization and addressing all five objectives of it.

Already included in the cross-cutting section. Referring to an old version.

Page 29: These objectives can be achieved conceptually in two types of scenarios:
- A fleet of fast neutron spectrum reactor that simultaneously produces electricity and offer the possibility of full or partial actinide transmutation. allowing the sustained management of U and Pu

Duplication

Page 30:
A double strata reactor fleet. The first stratum being a set of critical reactor……. The reactors in this stratum can be either present or future thermal reactors or fast reactors or an appropriate combination of both.
Scenario studies including industrial implementation…..take into account combination of various reactor types including LWR FNRs ADS, as well as the growing contribution of renewable energy sources.
Proposal to add: Continuous R&D effort is required to assure a continued performance in U and Pu-management during the transition from today's to tomorrow's more sustainable nuclear energy systems. The transition will be slow and will demand gradual though decisive developments seeking to comply with all sustainability criteria. Without this transitionary phase, no even more advanced nuclear fuel cycles can be envisaged.

Partially accepted (refers to previous version)

The deployment of even more advanced fuel cycles incorporating increasingly partitoning and transmutation involve large technological challenges on:

Page 30: Short term common trunk R&D on:
- Advanced reprocessing of LWR and advanced fuels leading, in the medium- to longer-term towards further improved U/Pu-management and gradually to MA separation, using either hydro- (including coprecipitation mix oxide uranium and plutonium) or pyro-metallurgical processes

Not accepted (refers to previous version)

Page 30: Medium term R&D for Demonstration facilities:
The decision to develop or not demonstration facilities for Fuel fabrication facilities and Reprocessing facilities should be taken during the next period till 2020 depending on the results of the previous steps and the European availability of equivalent facilities.

Not accepted (refers to previous version)

NUGENIA

Introduction
P 32:
Correct the list of area: "Innovative LWR design "instead of "innovative GenIII design"

Accepted

Technical area 6: innovative LWR design
P50
§ Scope:
Area 6 provides guidance for setting up R&D projects on innovative technology for light water reactors. Transverse technology will be developed for different reactor designs with their own and specific requirements for sharing new routes towards innovation.. The roadmap is organized in five sub-areas corresponding to R&D challenges in line with those objectives.
Duplication

§ iv) objectives
Consideration will be given to existing reactor designs as well as to the development of advanced light water reactor concepts that will feature improved sustainability

Not accepted (refers to previous version)

§ v) state of the art

The concept of high conversion light water reactor has been intensively studied during the 80's and was driven by the motivation to combine the advantages of LWR technology with the usage of uranium- plutonium as fuel, high burn up and low nuclear fuel consumption.

Already in the text

§ vi) challenges

Those challenges will be addressed through the work done in the 5 sub-areas spanning: materials and component related technology, advanced light water reactor concepts, specific safety issues, key success factors for the deployment of innovative LWR and public acceptance drivers for new build.
Not accepted (refers to previous version)

Knowing that new technology deployment at the industrial scale could be a long time duration process, the following time lines will be considered:

- Evolutionary technology for mid term application,
- Breakthrough technology for a longer term future,
- Advanced LWR designs such as with higher conversion ratio or small modular reactors, expected to be ready for commercial operation by 15 to 20 years.

§ 6.2 innovative LWR concepts such as high conversion ratio LWR, small modular reactor…

The purpose is to undertake all the necessary R&D work for preparing new Light Water Reactor concepts that could be ready for commercial operation within 15 to 20 years. For example, advanced LWR with higher conversion ratio, longer fuel cycle, and capable of U-Pu fuel multi-recycling, feature improved sustainability ; whereas small modular reactors offer a flexible and progressive approach to nuclear capacity optimization with limited infrastructure. These new concepts will foster and provide guidance for the development of innovative technology for reactor component design and fabrication, as described previously in sub-area1.
R&D topics:
Concept screening, including the literature review for these new reactor models,
Specific R&D topics derived from the previous screening: reactor physics, core cooling, compact component….
Assessment of the overall reactor system performance, in operating and accidental conditions

Not accepted (refers to previous version)

§ 6.4 Key success factors for innovative Light Water reactor deployment

Not accepted (refers to previous version)

CONTRIBUTORS

- SRIA editorial board: to be checked (
- Instead of "other contributors" to add "SNETP member contributors"

It is the Editorial Board of SRIA (that has two representatives from NUGENIA: Edouard Scott de Martinville and Petr Kadecka)
SNETP has organisation members not persons.

2.
I'd like to make some points with regards to the thorium cycle, and the MSR (comments by CNRS), which I think should be connected as a strategic solution.

With regards to the SRIA, one thing will have to be added: The HFR follow-up reactor Pallas has received 80 Meuro of Dutch government support for the first phase of realising this system. Similar to the HFR, Pallas targets to be multipurpose, and will combine nuclear R&D and isotope production. With the history of the HFR

in mind, being the main nuclear reactor facility contributing to European nuclear fission R&D (more than any other), where JHR or MYRHHA is mentioned in the document as supporting European nuclear fission R&D, HFR/Pallas should be added.
At this moment NRG is working on four ESNII relevant fuel irradiations (MARIOS, SPHERE, PELGRIMM, MARINE) in the HFR: please include HFR/PALLAS in the ESNII chapter where appropriate, thank you. For example page 54.
Introduced in addition to experimental reactors like JHR and PALLAS in page 53 (ESNII Introduction)

The comments by my colleague Ferry Roelofs I have sent earlier are all very valid, I recommend they be taken into account. Especially the classic mistakes with regards to passive safety, leadership, and economics of fast reactors, which are debatable in case not properly explained and elaborated.

Treated in comment 93

With regards to MSR and Thorium. I think it is very positive that there has been so much response via the public consultation! Let us be happy, that SNETP and the SRIA is regarded important enough to make comments to. It also means that these comments need to be taken seriously, and either personally addressed and answered, or taken into the SRIA. SNETP credibility to take public remarks into account (nuclear community is so often accused of the opposite) depends upon it.

Personally I think both Thorium and MSR are addressed in the SRIA appropriately: it is a realistic reflection of the current situation in Europe and the current perspectives of the fuel cycle and the system. I also believe that the combination of Thorium and MSR can make the ideal nuclear fission promise true (optimized resource usage, plentiful resources, minimized waste and very high safety levels), but the way is long and extremely costly. I also think that, if that is indeed true, we should not hesitate to say it: currently, political will and budgets associated only allow revolutionary nuclear technology development in the field of nuclear fusion. Apparently. And if the UK wants thorium and MSR, nobody blocks them to put some significant funding into that development, which is currently not the case.

Therefore I recommend to add in the answers to the MSR and Thorium people, and possibly also in the SRIA itself something (potentially controversial) like this:

The limitations in European funding and Member State support for nuclear fission R&D, forces to focus on evolutionary developments of improving safety and efficiency of existing nuclear power systems, especially in the wake of Fukushima and an ageing fleet of water-cooled reactors so significant for European carbon emission free electricity supply, and added to that the evolutionary development of new nuclear fission technology with an existing and strong European historical technology basis and a well justified and elaborated application perspective. Revolutionary development in nuclear power technology is currently limited to nuclear fusion, with apparent adequate political support and budgets associated to make significant progress on this long term nuclear energy option. At European level, the support for nuclear fission technology is too modest, in all respects, reflecting in ever decreasing and very small nuclear fission R&D budgets, to enable introduction of a new fuel cycle based on Thorium, and a new nuclear system like the MSR with hardly any historical basis in Europe. Nevertheless this might change, and therefore SNETP recommends that minimally the knowledge base in the field of Thorium and the system that can most effectively use Thorium resources (i.e. MSR) is maintained, effort for which depends ultimately on the support that can be found in individual Member States.

Partially accepted. Many of these concepts had been introduced in a new paragraph of the SRIA.

On the other hand there is no harm in adding a specific section to Thorium I think, and add the MSR as a system that can potentially make optimal use of the thorium resource in the long run. It could be put under fuel cycle development, and all references to thorium could be collected in that section. It will show the remarks are recognized (although they most likely will not think it is enough), and whether this will lead to European programs, ultimately depends on the willingness of Member States and European institutes/academia/industry to counterfinance, not on the SRIA (which already allows thorium/MSR programs in principle in the current version).
I think it would not be wise to exclude the comments entirely: it could damage SNETP reputation. Ultimately SNETP should represent the majority of the nuclear community in Europe, although that does not mean SNETP

will have to make everybody happy. But the nuclear community is often accused of not taking public opinion into account, and looking at the front page of a major newspaper in the Netherlands last week which had thorium and MSR on the whole of the front page (really!), denying this interest would be damaging. I will try to send this (left-wing!) newspaper front paper in my next mail.

3.

in my opinion the SNETP SRIA gives a good overview and good directions for R&D on nuclear topics. Therefore I have just a few remarks and comments. Please access the pdf file here

1st: The impact of Chernobyl and TMI has already been taken into account through a continuous improvement process.

2nd: Accepted and added

3rd: Accepted and added:
The major challenge to a generalized adoption of passive systems for safety purposes is the achievement of a convenient and exhaustive full scale demonstration of their reliability in transient conditions. Specific R&D is to be devoted to provide evidence of the system reliability despite the approximations and assumptions in the validation experiments and to clear the way to extrapolation.

4th: Those are objectives from TA2.

5th: SRIA has to be in compliance with the organisation of NUGENIA.

4.

1. I appreciate the new structure of the SRA containing the NUGENIA Association and industrial initatives ESNII and N2IC.
2. NUGENIA has included more topics than the SRA 2009 „pillar“ or the chapter"Current and future Light Water Reactors". My comments are aimed at the NUGENIA program.
3. I highly appreciate the inclusion of the innovative LWR design and particularly the small modular reactors in the NUGENIA Technical Area 6 (TA 6). Small reactors are mentioned properly in several paragraphs of the TA6.
4. It seems that considerations on the use of small modular reactors have been neglected inEurope - compared with initiatives in the U.S., Russia, Asian countries and the IAEA. Due to the active development of small reactors in these countries it can be expected that these rectors may be commercially deployed earlier than in 15-20 years, as stated in the TA 6 (6.1)– particularly ones of the LWR type which do not need much research and development
5. I recommend to include a separate topic “Small modular reactors” into the TA6.
6. It would be reasonable to establish cooperation with the IAEA (as in other topics in the SNETP), because the IAEA provide support to its programme Small and Medium reactors.

SMR is sufficiently covered in the NUGENIA chapter.

5.

The latest SRIA proposals on EU spending on atomic fuel does not give any research money for thorium fuel reactors.
I write to ask if this situation could be changed?
Please check the annex "Clarification on SNETP position on Thorium and MSR research".

6.

I regularly follow the progress & innovation concerning nuclear fission energy. SNETP has recently made available a draft version of the document "Strategic Research and Innovation Agenda", in order to define the policy and strategy for nuclear research in the EU.
When reading the document I was surprised by the very low importance attached to Molten Salt Reactors (MSR) and the Thorium fuel cycle, despite the high interest of the configuration in terms of flexibility and safety. I remind you that this field of energy production with MSR/Thorium is the subject of intensive research/development programs in India, the USA & China.

The high level of experience in Europe with fast breeder reactors (particularly in France with Phenix, Superphenix and now Astrid), should not obstruct the sustainable potential of MSR reactors for the close future. At the present time, when nuclear energy is in "the hot seat" (Superphenix was rejected by the public), it would seem unwise to ignore or underestimate this other promising alternative.

There are many reasons to be interested in MSRs and the thorium fuel cycle:

- More easily accepted by the population, due to the intrinsic high level of safety (that's very important !).
- No use of sodium, requiring specific/complicated technologies & processes (imagine Fukushima with a sodium reactor…).
- High level of efficiency and flexibility with the possibility to easily "burn" various fuels, including nuclear wastes like plutonium and long term actinides.
- Not necessary to stop the reactor for maintenance and replacement of the nuclear fuel.
- As a consequence, there is a reduced amount of radioactive matter inside the reactor itself (that could cause problems in case of an accident)
- With thorium fuel used in a molten salt reactor with suitable salt reprocessing, ultimate wastes have relatively short half lives and are limited in quantity
- It is also a breeder reactor, meaning that fuel resources are "almost infinite" particularly when using Thorium
- Simple & reliable design, despite the necessary "cleaning unit" for the salt.
- Several small MSRs have been already developed and tested with success in the past. Nevertheless additional studies must be performed to be industrialized.

Energy is the key for the future. With the end of the "carbon age", it is very urgent and important to correctly identify pertinent opportunities, avoiding "classical and shaky" solutions, more often advocated by other Gen IV competitors.

MSR/Thorium system is neither too complicated nor too futuristic, contrary to what is commonly sustained by its critics and Generation IV competitors. We should be wary of jumping to conclusions too hastily, and denials of reality. Money already invested in research & development along pathways that at the time seemed promising (sodium breeder reactors), is clearly not a reasonable justification to persist in a direction which may be outdated. The challenge for the future is too important to act purely on the basis of precedence…

I would like to add that such breeder reactors (e.g. MSFR) could be rapidly deployed as long as a real political will and suitable programs are defined. That is the purpose of this mail, so that Europe does not "miss the boat"!

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

7.

The world excluding Europe is excited by the safety and cost benefits arising from the potential of Thorium nuclear reactors for future power generation. This technology needs to be properly addressed in upcoming SRIA. It is time to stop vested interests from dictating the agenda and to start work on a safer form of nuclear power generation that puts the interests of all the people of the EU first.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

8.

Figure 4 is not completed

Pag. 63, the major industries for ALFRED project are not mentioned, while in all other project they are mentioned

OK. ALFRED industries have been included in the new text.

9.

I am writing to record my strong objection to your proposal to exclude the development of thorium based nuclear reactors as a future technology within the EU. This does not make any sense in a highly competitive world
Energy costs in Europe are the highest in the developed/developing world due to the unrealistic and virtually unilateral focus on expensive and unreliable renewable energy (largely wind turbines). This high cost is driving industrial manufacturing from Europe to countries where dogma is side-lined and replaced by pragmatism – as a means of attracting industry, encouraging growth to improve their economies.

Whilst the large manufacturing countries – such as China and India – are continuing with their increased coal and gas based electricity generation, it simply does not make sense for the EU to hamstring its industrial base unilaterally – this is a recipe for failure and ultimate disaster. The EU simply CANNOT save the planet on it's own and until (if) there is ever an effective worldwide carbon emissions agreement it is sheer madness to do this on our own.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

10.
I write in connection with today's article in the UK Daily Telegraph concerning Thorium Energy and wish to register my support for the diversification of funds to support alternative Nuclear Energy approaches other than the existing (clearly limited and potentially dangerous) technological solutions.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

11.
I object most strongly against your consultation re banning thorium reactors.
Our energy costs in Europe are the highest in the world due to renewable energy and yes the cheap source or nuclear/thorium is being denied.
Manufacturing is leaving Europe.
Other countries are now turning to coal and gas thus increasing CO2 emissions and you think that Europe will save the planet.
The result will be anarchy and I hope there will be a day of reckoning for those proposing this stupid and destructive idea.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

12.
I understand that Thorium nuclear technology has been completely overlooked/ignored in the draft SRIA.
As something that I understand provides potential for clean, cheap and safe nuclear power and is a technology that other major nations are investing in considerably, I would suggest that provision should be made into research into this technology and it should be part of Europe's nuclear strategic research, or if not at least clear reasons be given for it not being included.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

13.
The NNL and I believe that the SRIA needs to have a more comprehensive reflection of the Thorium and the Molten Salts Reactor annexes from the previous SRA in the text of the revised draft
I have attached the previous versions of the annexes for your information and for consideration. There has been significant interest in these topics world wide of the past few years and not having a more serious reflection of the R&D requirements needed to keep pace with these developments could leave the EU R&D support wanting in international fora. PROF. DR. THOMAS FANGHÄNEL made reference to the very short and confusing reference in his comments on the 19/10.
I would be grateful if the drafting team could consider this request for inclusion in the final version of the SRIA

Thank you very much for your comment on the Thorium issue.
The SRIA has been modified to reflect more explicitly the place of Thorium fuel cycle and MSR as longer term, but important, possibility. The two annexes on Thorium and on MSR are still in force even if they have not been repeated in the SRIA.
Please check the annex "Clarification on SNETP position on Thorium and MSR research".

14.

I am only a private citizen not a scientist.
However I cannot understand why when China is investing so much in developing thorium as an energy source we in Europe are neglecting to follow their lead.
I cannot believe that they are throwing their money on a bonfire!

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

15.

Having at a late stage been made aware of the state of nuclear research, funded by the taxpayers of Europe I urge you to promote more investigation into power using Thorium.
It may not supply an exclusive answer to our exponentially increasing energy needs, but seems, even at a cursory glance, to provide an effective result to energy production.
Just as importantly it would appear to be as safe as one may make a reactive system of this sort.
Please do not consign Thorium research to the 'back burner' and allow vested interests to have the lions share of the budget attempting to 'better' old technology.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

16.

I urge you to fund European research into Thorium as a nuclear fuel technology so that Europe can keep all options open in the search for economic methods of electrical energy generation.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

17.

I would like to see more funding for Thorium research as it is much safer than conventional nuclear power

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

18.

I am extremely concerned that the SRIA is almost entirely slated to support research in Uranium fission uses at a time when the entire world is moving away from these for safety reasons.
Although fusion systems are still a long way off, the level of worldwide interest and sound scientific basis makes Thorium-based research a topic that cannot justifibaly be avoided.
The SRIA allocation of funds seem lmost exclusively designed to prop up French national research into heir fission systems. Whilst it is realistic to help support this, it is positively Luddite and nepotistic to so completely avoid Thorium at a time when everyone else is investing in it.
In my view, the SRIA as drafted is something that should be funded as a French national project rather than by the EU partners.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

19.

I would like to enquire as to why there appears to be no appetite for funding toward the EU Thorium based nuclear model that is being researched heavily by the US, Japanese, Chinese, Russian and Norwegian governments.
I am no scientist but it appears from the readings that I have undertaken in the last few weeks that there are many advantages particularly long-term in the development of Thorium based reactors where as the Fukushima disaster has taught us of the short comings associated with the traditional fission reactors.
As a European Tax Payer I think it is remiss of SNETP not to invest more heavily in this area at a time when energy security is such a serious matter.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

20.

carrying out detaile research into the viability of Thorium reactors
A l'attention de: SNETP’s Strategic Research and Innovation Agenda and all European governments

Cette pétition est très importante et nécessite notre aide. Clique ici pour en savoir plus et signer:
http://www.avaaz.org/fr/petition/carrying_out_detaile_research_into_the_viability_of_Thorium_reactors/?eTjynbb

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

21.

Firstly the perception across the channel is that agency is little more than a thin facade to channel European taxpayer money into projects that benefit the French national interest. I suspect this both a simplification and does the agency an injustice. However clearly you will have to work harder to disprove this label. This has led to the agency being branded as irrelevant in the UK, other than yen another example of veiled EU fraud.
Secondly I am a great fan of the potential for thorium reactors, I despair at much of the renewable debate as it mostly represents an idealised money pit. Thorium however has always been in my mind the most likely nuclear technology to actually deliver the clean, sustainable and cost effective energy needed. It is with great concern therefore that it is being reported in the UK that the agency is discounting it. Again this is being reported as an another example of either narrow French self interest or French short sightedness.
Can you provide me the rational for it's near omission in the 2013 strategy agenda, especially can you contrast this with the progress being made particularly in China. Again the UK this is being portrayed as China wrong and France right? The inference is that this nearly never true.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

22.

I would like to see more funds invested in the development of Thorium reactors as in my opinion this could be the way forward. China and several other countries are doing this we do not want to be left behind in Europe.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

23.

Eurpoe should be taking notice of the activities of China, Japan, India, Russia, Norway, and the US Academy of Sciences in respect of the Thorium fuel cycle and the prospect of safe, clean, and ultimately cheap energy from thorium nuclear reactors.
See: http://www.telegraph.co.uk/finance/comment/ambroseevans_pritchard/9784044/China-blazes-trail-for-clean-nuclear-power-from-thorium.html

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

24.

I urge you to direct a meaningful proportion of your budget to thorium reactor development.
To ignore this avenue would be short sighted, particularly at this stage of the development programme.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

25.

I strongly request that thorium research is properly and adequately funded to provide an alternative and safe power source

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

26.

Can you please ensure that research into thorium reactors is included in the funding arrangements for future nuclear energy production. At the moment most funding is direstedtowards the older uranium based technologies that have served us well in the past. This is the time to look into the future.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

27.

As Germany phases out conventional light water nuclear reactors, they should not be replaced by polluting coal plants. Instead, LWR plants should be converted to using liquid fluoride thorium reactors (LFTR aka molten salt reactors--MSR) or replaced by new plants using LFTR. This power source is safe and economical. It is cheaper

than coal and more practical than solar and wind power, which are intermittent. MSR was proved safe and practical by successful operation 1969-75 at Oak Ridge National Laboratory in Tennessee, USA. Go for it!

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

28.

Why is the EU through SNETP not significantly funding thorium research as a safe alternative nuclear energy source?

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

29.

I wish to voice my concern about the direction of Euratom's forthcoming research agenda. In an age in which Europe's economy is crippled by the lack of affordable fuels, it is imperative that Europe should not be left behind in the development of Thorium as a nuclear fuel. Thorium is potentially safer and more vesatile in its use, produces less long term waste and is much more abundant than uranium. China is already researching thorium and it would be a travesty if Europe was to be left behind on what could be mankind's greatest energy breakthrough since the discovery of fire.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

30.

please reconsider spending more money on thorium research. for the good of the planet. for the good of us all!

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

31.

In your deliberations please don't ignore thorium as a form of fuel. It could be so much safer and provide for a significant improvement for the future of our children.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

32.

The Weinberg Foundation welcomes the opportunity to respond the public consultation on SNETP's 2013 Strategic Research and Innovation Agenda (SRIA). As strong proponents of nuclear power, and enthusiasts for European leadership in science and clean energy technology, we naturally support all policies that further the research, development and commercialisation of new fission technologies. We strongly support SNETP's vision of a safe, clean and sustainable nuclear energy system for Europe.

However, we are concerned that the omission of two key research projects from the draft SRIA –thorium fuel cycles and molten salt reactors - will gravely threaten current and future research into two of the most promising routes to innovative, safe and sustainable forms of nuclear power. We therefore urge SNETP to acknowledge the importance of research into thorium and molten salt reactors by revising and inserting the previous Annexes on thorium (January 2011) and molten salt reactor systems (January 2012) into the final SRIA 2013. (pdf)

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

33.

I am deeply concerned that your strategy relies entirely upon the existing technology of uranium based fusion. This has no future, and you should be exploring the possibility of Thorium technologies, which will not generate the same environmental concerns in the long run, with almost limitless supply of fuel.

This strategy seems to reflect the interests of the existing players in this field who wish to maintain the status quo, and not to be an independent appraisal of the best technologies for the future.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

34.

It is with great alarm that I have learned of your plans to exclude Thorium based reactors from future EU Nuclear research Thorium offers the prospect of an intrinsically safe, low waste nuclear energy source.

It is of the highest importance that the EU fund research into nuclear energy employing Thorium as a feedstock.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

35.

Ayant suivi l'état des recherches dans divers pays (notamment la Chine) au sujet de l'élément Thorium je pensais que l'Union Européenne aurait été également capable d'anticiper les évolutions dans ce domaine. Bien que la France soit au coeur de l'industrie nucléaire en Europe je pense qu'il faut faire preuve d'inventivité au lieu de rester figé sur les acquis des générations antérieures. On risque, me semble-t'il, de tomber dans une attitude rétrograde voire sclérosée au moment même où des pays concurrents prennent de l'avance (encore une fois...). N'oublions donc pas la place que pourrait occuper le thorium d'ici 20-30 ans.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

36.

It has been brought to my attention that the next round of EU funded Nuclear research is not going to give much (any?) focus or funding towards Thorium based technology.
This seems like a massive strategic mistake. This is clearly a very promising area to research and should be exactly the sort of thing that receives funding.
Please reconsider and put a sufficient percentage of the budget towards Thorium based research.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

37.

My input is that there is a big concern on the lack of attention the Thorium reactor R&D, which needs to be addressed urgently.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

38.

I have read your proposals for future funding of nuclear technology. I am left wondering why there is no room for even a small-scale pilot project based on Thorium. Given the emphasis being given to this technology in other competitor nations I wonder if you could provide an explanation for this omission.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

39.

Having read the draft document and noted the paragraph about about Molten Salt reactors, I am dismayed at the little effort going into this exciting technology.
The amount of Thorium in the world and the fact that we can use upwards of 90% in Molten Salt reactors meaning we have little waste to store and to produce energy in a safe and controllable manner means that it will last for some thousands of years.
I realise that there is some development work to do on the technology, but the fact that a successful experimental plant was run in the 1960's surely means that with a moderate amount of effort we could get this to work with the advances we have made in Science in the meantime. As Alvin Weinburg said “I can still remember the thrill that came with my realization that the breeder meant inexhaustible energy.”
“I became obsessed with the Idea that humankind's whole future depended on the breeder.”
Surely this is even more true today, with Countries dropping Uranium reactors following Fukushima.
As I am sure you are aware China is working on Molten Salt technology as are Flibe Energy in the USA and several other countries.
Thorium exactly fits the criteria that is set out at the start of the study. 1. Optimum use of natural resources. 2. Nuclear Waste minimization.
The world is desperate for a safe, economical, non-Co2 producing form of energy and the Molten Salt Reactor fills the bill almost perfectly and it can be used to dispose of waste Uranium and Plutonium as well.
Please give this technology some time and money.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

40.

Thorium. That's where the research money must go.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

41.

Fund research on U233 reactors with breeding from thorium 232

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

42.

As a Norwegian, the ever increasing ocean acidification concerns me. The rate of change we see the ph is changing in the Northern waters of the Atlantic, called the Norwegian Sea, is alarming. The increasing concentration of CO2 in the atmosphere is the cause of this negative development.

France´s historic focus on nuclear power has helped to moderate this negative development but the recent rapid industrialisation of countries like China and India and other former third world countries now owershadows the former gains.

The world certainly needs a new form of nuclear energy to replace both the coal powerplants and then reduce liquid and gaseous hydrocarbons. The only nuclear power that has the potential to do so is the Molten Salt Reactor wich can be run on both Uranium and Thorium, or preferable a mix of these. I urge you to look into this and look at all options thinkable of these issues and not close the book due to the wish for military nuclear material.

If we don´t stop this negative development in oceanic acidification the civilisation as we know it can be under threat. The Norwegian department of environment thinks so at least but they also belive the solution is windmills in the following article: http://www.regjeringen.no/nb/dep/md/dok/regpubl/stmeld/2008-2009/stmeld-nr-37-2008-2009-/6.html?id=560227

The article is available both in Norwegian and English. There is a "English" button up to the right.

The enclosed article gives us a limited time to handle the development to avoid severe consequences for our climate and we need to develop a cheaper version of nuclear power to handle this and the best candidate I see we have is the Molten Salt Reactor of some sort.

I just ask you to look into this seriously and try to think a little different than usual!

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

43. Research into Thorium please

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

44.

Your website promises that public input will “contribute to the development of safe, sustainable and competitive fission energy in Europe” yet the proposed allocation of research spending is predominantly to fusion.

Whilst fusion may have great promise there is no prospect of any commercial application for decades.

Fission on the other hand promises early breakthroughs and commercial application in a number of areas, notably thorium.

I would rather see resources to fusion research cut and diverted to thorium research and other promising fission reactor technologies using the traditional Uranium fuel cycle. It seems to me that research funding is instead allocated to the long existing grand projects and that these have singularly failed to deliver any benefit for decades.

This is not a time when Europe can twiddle its thumbs, the rest of the world is moving ahead anyway and Europe is in a generational economic crisis. We cannot afford research that does not give a quick payback in this economic climate and we cannot risk being left yet further behind by the rest of the world.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

45.

More money must be invested in thorium fission, and potential fusion technologies, and not so overwhelmingly in French projects

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

46.

We are writing to you as members of the UK Parliament’s All Party Parliamentary Group on Thorium Energy, which is exploring the potential of thorium-fuelled reactors to deliver safe and efficient nuclear power for the future. We are pleased that thorium fuel cycles and molten salt reactors (MSRs) are mentioned in the draft SNETP 2013 Strategic Research Agenda (SRA), and that the previous SRA was updated last year with a detailed annex on the Molten Salt Fast Reactor (MSFR).

We were disappointed, however, that the focus on thorium and MSRs in the new draft is not as substantial as it was in the 2012 annex, and we are concerned about the impact this may have on future funding for thorium and MSR research in the EU. We would strongly encourage you to consider including separate sections in the new SRA on thorium fuel cycles and molten salt reactor systems.

In recent years, Europe has been the global centre for thorium and MSR research and development, with groundbreaking programmes at France’s Laboratory of Subatomic Physics and Cosmology (LPSC) in Grenoble and the Czech Republic’s Nuclear Institute Rez. In addition, EURATOM is supporting the MSR programme taking place in Russia at the Kurchatov Institute. China has recently launched the world’s largest MSR programme, investing $350 million in the initial phase of the project, which aims to build a 2MW research MSR by around 2020, and a 2MW molten salt cooled reactor by 2017.

MSRs offer outstanding safety benefits including passive temperature regulation and low operating pressure. The liquid fuel in an MSR can be safely drained into dump tanks at any time during operation, should it be necessary to stop the chain reaction. In addition, molten salts are very effective coolants with high heat capacity which enables excellent thermal to electrical conversion efficiency. Some MSR designs include online reprocessing of the fuel salt which enables continuous removal of fission products, resulting in high fuel burn up. Coupled with abundant thorium fuel, MSRs will produce very little high level waste, and almost no plutonium.

European thorium and MSR research is a crucial part of the ongoing effort to transition to a sustainable, low-carbon energy future. We are concerned that the omission of a substantive section on thorium and MSRs from the SRA could marginalise European thorium and MSR programmes, just at a time when other nations, such as China, are forging ahead with work on this most promising technology.

We hope you will agree that there are clear scientific, economic and environmental reasons for the strengthening of European research efforts into thorium and molten salt reactors, and we encourage you to reflect this in the forthcoming SRA.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

47.

I am surprised - given China, Japan and Norway's commitment to the technology and last year's SNETP report on the subject - that the EU appears to be turning its back on the use of thorium as a nuclear fuel.
Is this in the interests of all EU citizens?

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

48.

I have reviewed the draft document, as a former research scientist at The University of Oxford, Department of Metallurgy and The Science of Materials, and possessed of the requisite security clearances for admission (in 1981) to the United Kingdom’s plutonium reprocessing effort.
I note that the Thorium cycle concepts that are under active consideration in other jurisdictions are not afforded any great weight in this document, reflecting a bias towards existing commercial enterprises within the Union. This is unsurprising, but disappointing and intellectually unsatisfactory. It should not be necessary to remind practicing scientists and engineers that the interests and prejudices of the French Republic are identical neither with those of the Union as a whole, nor with rationality.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

49.
S'il vous plaît pardonnez mon français, ce n'est pas ma langue maternelle.
Je crois que vous consuting le programe de l'Europe de l'énergie nucléaire.
S'il vous plaît envisager de minerai de réacteurs au thorium - ils sont nettement plus sûrs que les technologies actuelles que le financement est dirigé vers.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

50.
I would like to know why SNETP's Strategic Research and Innovation Agenda does not include research on the generation of electricity from nuclear reactors which use thorium as their fuel source.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

51.
It is very important to redouble efforts on Thorium R & D

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

52.
The importance of moving forward with the Molten-Salt Reactor (MSR) for clean power and consumption of LWR spent fuel cannot be underestimated.
Support for subsequent steps to move to Thorium-salt powered MSRs also cannot be underestimated. Even Thorium in solid fuel is a good step.

Countries around the world realize now the extreme value of the work done to demonstrate the MSR at US ORNL in the 1960s and '70s. For Europe to discount and ignore the importance of completing this work is to guarantee Europeans a distant second place in clean energy and science. This is especially saddening given Germany's recent decisions to build more coal plants, even a 2GWe lignite0-burning one -- an environmental disaster.
It's hard to imagine that Europe wishes to occupy a distant second place in world energy R&D, while china and others move quickly ahead, capturing energy markets and providing excellent educational and job opportunities for their people.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

53.
I find it very odd indeed that there do not appear to be any funding proposals in respect of research into Thorium -based nuclear power generation technology, given the way that other countries have started running with the ball on this promising avenue of research. The Chinese government, in particular, are engaging in a serious effort to explore and validate thorium/molten fluoride salt reactors, having availed of the research documentation of the Oak Ridge National Laboratory in the USA, something which to my knowledge, remains open to all.
Given the unsatisfactory safely record of Light Water reactor technology, as well as the legacy of nuclear waste and huge cost overruns on the latest reactor builds, surely it would seem prudent to invest a few hundreds of millions of Euros on Thorium/MSR R&D, preferably in collaboration with other countries, to provide an alternative to the existing LWR model and U235 fuel cycle.
If the Chinese are successful in their venture and establish sufficient intellectual property rights, the European nuclear industry could find itself out-competed in foreign and even domestic markets. The stakes here are potentially huge, so I urge you to take a strategic view and devote significant resources to Thorium reactor and fuel-cycle research.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

54.
I should like to add my support to the proposal that a significant proportion of the research funds provided by the EU taxpayers is directed towards to Strategic Research & Innovation as described by the very title of your

agenda. In particular this should include investment into research relating to alternatives to uranium as a nuclear fuel with the inherent issues that exist in its use. This has been highlighted most recently with the Fukushima disaster in Japan.

It makes significant sense to adopt the approach of other countries such as China and USA to focus a significant element of the budget in examining further the potential of molten salt thorium reactors as highlighted in a report from SNETP last year. It makes no sense for the vast majority of the budget, 86% I believe, to be spent on the vested interests of the existing nuclear industry which is contracting rapidly as a result of current and planned closures of reactors across much of Europe including Germany and the UK.

The focus of funding should enable nuclear physicists to consider in detail, including the development of accelerator driven sub critical reactors to allow Europe to compete and indeed lead the world in the future of nuclear power generation. The base is there the funding needs to follow. Focussing the funding on existing technology is merely subsidising an industry that has not created a future vision that is viable.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

55.

We need to spend more of Euratom budget on thorium reactor research and the development of energy through their use.
Please spend more of the budget on thorium research.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

56.

Had a quick look at your document. I skipped through it looking with the keyword Thorium.
While in the near term the only viable form of nuclear power is uranium PWRs which you admit are dirty and only use 1% of the fuel. It seems a shame that more is not being done to bring about the promises in Thorium technologies.

Looking at worldwide interest in Thorium technologies the benefits have not gone unnoticed in Japan, China, Russia etc. It seems a shame that this enthusiasm elsewhere is not shared in the EU where we need the development of sustainable cleaner energy technologies as much as anyone else. This even without the silly and arbitrary targets of 20% for this and that. The population would be more impressed with a clean sustainable but viable source of energy rather than tilting at the windmills (Don Quixote) of artificial targets and political grandstanding.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

57.

The Strategy is set out clearly but omits the very important issue of Thorium as a fissionable material and research into its use. The report you commissioned was very positive and I would urge you to consider including more emphasis on exploring new Thorium technologies and the different approaches.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

58.

I'm writing as a scientist with no particular expertise in nuclear fuels though with a longstanding interest in the matter but I would like to add my weight to the plea that it would be foolish not to be giving serious thought to the possible future role of Thorium. Its promise may melt away in the face of hard-headed study but given the clear need for fission for decades to come (renewables simply cannot get us through on their own - that's simple arithmetic) and the problems of waste and decommissioning costs of uranium-based technology, its fundamentals would seem to warrant serious study. Some other parts of the world seem quite keen at the present time.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

59.

I feel strongly that nuclear energy generation via thorium-fuelled reactors represents the only 'clean', long-term method of meeting future energy needs while minimising carbon emissions and nuclear waste. I urge you to support financially all proposals which recognise this.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

60.

I note from the Consultation Paper that there is little, if any, thought given to Thorium Nuclear Reactors and Molten Salt Thorium Reactors, both of which are considered far, far safer than traditional Uranium Process. Your organisation should make funds available for this new, vital alternative to the future of nuclear power generation.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

61.

The authors of this report have failed to address adequately the 3 main reasons against further development of Uranium based Nuclear.

These issues should be placed at the beginning of the document and the reader should be guided to the answers - in so far as there are any.
Otherwise the suspicion is that the report has been written by scientists and technicians who are locked into Uranium based Nuclear and are blinkered to these fundamental problems.

The main reasons against Uranium fuelled reactors are:
Uranium based nuclear reactors produce more high level waste than reactors using other fuels such as Thorium and despite the Nuclear Industry's best efforts there is still a shortage of long-term storage capacity for high level waste.

Nuclear proliferation is seen as one to the greatest threats to global security. Uranium based nuclear technology produces significant amounts of material for bombs (unlike other fuels like Thorium)

Uranium ore is relatively scarce compared to Thorium and competition for the supply is intensifying rapidly.

The logical conclusion seems to point to Thorium as the fuel of choice - despite the slow progress in developing Thorium reactors in Europe this should be the way ahead - if not please explain more fully why not.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

62.

I ask that you pay significant attention to the benefits of Thorium nuclear energy and include this in the options for nuclear energy policy.
I also ask you to note that it is critical that this agenda be seen across Europe as an independent and impartial policy, not just one that is disproportionately favourable to embedded French nuclear energy interests, as current funding and the current policy suggests. Why should a country take part in, let alone fund, a Europe that is so blatantly biased towards one country at the expense of others and at the expense ultimately of a strong Europe in the future. Lack of impartiality is a factor that is destructive to the European ideal and just encourages those who believe the EU can no longer be trusted.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

63.

Thorium Cycle please

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

64.

I strongly urge that the EU adopt a major policy of investigating and preparing to use Thoriun reactors as preferred to Uranium based reactors, in the interests of safety and long term viability and economic sense.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

65.

I am very disapointed that SNETP is pouring money into old fission reactors and even more into fusion, which is unlikely for decades to prove value for money.
It is instructive that the list of collaborators is totally dominated by French, EU and German companies and organisations without a single British element. As Ambrose E Pritchard suggests, it seems high time Britain removed itself from EU out -of-date, out-of-touch projects.
Like everything else connected to the EU, it suggests deplorable value for money.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

66.

I have been informed that your institution is allocating no funds to Thorium reactor research and that the lions share of your research funding is being allocated to Nuclear Fusion technologies.

May I ask why this is so? It seems to me this would be a wonderful opportunity to start serious research into the possibilites of Thorium power. Thorium is in plentiful supply in the earths surface and is regarded as very safe as it cannot explode like the Fukushima reactors. This I thought would be the nuclear technology of the future. What is not to like about it, its cheap, plentiful and safe. I appreciate there are technical difficulties still to be overcome with Thorium but given the benefits I thought this would make research only more urgent.

I understand your own research has been very favourable as regards Thorium with a report published last year which viewed Thorium power in glowing terms.

I look forward to receiving your reply regarding why funding is not being allocated to Thorium research and your plans to remedy this deficiency.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

67.

I am surprised at the lack of emphasis and interest being shown in Thorium reactors.
If this is not corrected I am concerned that Europe will once again lag behind other world powers

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

68.

I would like to comment on the Strategic Research and Innovation Agenda as a concerned member of the public.

1. Enrico Fermi considered that a Thorium cycle would be superior to a uranium cycle for the production of energy. He, better than almost anyone else, understood the physics, and his opinion stands as being worth listening to today. I would therefore ask that a significant part of the SRIA consider routes by which a Thorium cycle reactor maybe researched.

2. The various uranium/plutonium reactor accidents that have occurred over the decades have left the public deeply distrustful of nuclear power, yet it offers the only realistic hope of providing energy that will not add to greenhouse gases. It is therefore incumbent on both scientists on politicians to pursue courses of action that will have the confidence of the public. Arrogantly pursuing routes that the public will not stand for will ultimately result in failure to adopt such routes, and further probably to catastrophic damage to the planet. Therefore, the strong moral imperative is to pursue clean nuclear power, and this probably means a Thorium cycle.

3. There are far-sighted governments around the world who are seriously investigating a Thorium reactor - China, the US, Norway, Japan. The sensible approach is to strike a collaborative agreement with one or more of these governments, and pool resources to dramatically increase the chances of success. It is the sensible and moral route to take, and I expect nothing less from Europe's leaders.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

69.

Thank you for the opportunity to comment on the SNETP Strategic Research and Innovation Agenda (SRIA). Here are my comments :

1. pages 4, 16 and 80 : The Introduction - and therefore the Executive Summary and the Conclusions - lack perspective. Even if they refer to global energy demand at future dates (2035, and even 2050), they describe primarily the current role of nuclear energy and the necessary research to sustain existing reactors. They do not really open a wide perspective on the future, nor do they explain and justify the strategy underlying to the recommended research. The Strategic Energy Technology Plan provides general clues but not a detailed analysis of the nuclear research strategy. Besides, the SRIA, which concentrates on uncertainties regarding nuclear safety raised by the Fukushima accident - this is understandable in the prevailing political and social climate but not fully balanced and partly out of focus with respect to safety research real needs and priorities - does not mention, even briefly, uncertainties caused by rapid development of renewable energies on the one hand and inflating costs of EPR construction and the slow response of governments and nuclear industry to the development of Generation IV reactors on the other hand (GEN IV reactors may ultimately become available at a time when they are not needed any more...). The medium to long term perspective is crucial to answer key questions about research : Why is research needed ? What is its purpose ? What are its objectives ? What sort of results do we need ? On what time scale ? What are the priorities ? What is the best way to organise research, considering that human and financial resources are limited ?

These points are being addressed in the EU Symposium (26-27 Feb 2013) and the EU Study. The discussion of the optimization of the energy mix in Europe is beyond the scope of the SRIA.

2. page 5 : The first sentence of "Safety vision" gives a truncated view of the situation. I suggest to replace it by a text along the following lines : " The safety of nuclear installations results from the combined efforts of designers, operators, regulators and researchers. While designers and operators have the duty to conduct their own research, regulators rely on anticipatory and confirmatory research conducted by research organisations, which also have to explore new avenues and issues and alert the other partners about potential consequences. Dedicated research and development, and pervasive safety culture, are key factors in the permanent process of improvement of nuclear installations and their safety."

Partially accepted.

3. page 6, 10th line of "Sustainability of the Nuclear Fuel Cycle", and page 25 : I think a third objective is necessary : " Minimum impact on environment (As Low As Necessary)". Alternatively, this wider objective could include "Nuclear waste minimization" as a subobjective.

Partially accepted.

4. page 8 and page 34 : NUGENIA TA2 : Severe Accident Management (SAM) consists of those actions, usually using existing equipment (instrumentation and hardware), that are taken by the plant staff during the course of an accident to prevent core damage, terminate progress of core damage and retain the core within the vessel, maintain containment integrity, and maintain the reactor in a stable condition with the release of any radioactive material under control. The overall objective is to further reduce the risks of large releases. Although SAM is generally thought of as taking place after the onset of core damage, it also involves pre-planning and preparatory measures for SAM guidance and procedures, equipment modifications to facilitate procedure implementation, and severe accident training. Although it is the responsibility of the licensees to develop and implement a SAM programme, research will help plant operators in this task, and it will enrich the set of tools available to regulators to assess the effectiveness and robustness of SAM measures deployed and planned by operators. I suggest to add "Severe accident management related research" to the list of highest priority safety challenges.

It is already covered.

5. page 12, middle on the left side: "The HTR technology builds on the developments in Germany in the 1980s". This is true, but it also builds on developments in the UK and the USA in the 1970s and 1980s.

Included in the final text.

6. pages 12 (Nuclear cogeneration) and page 72 : The use of process heat from nuclear reactors in chemical processes requires short distances between the nuclear and the chemical plant (refineries, petrochemical plants, hydrogen production plants, etc.). HTRs and VHTRs providing heat for industrial processes will be located within highly populated industrial environments, harbour installations, etc. Compared with electricity and steam generating nuclear power plants, an additional risk is caused by this close proximity. After the accidental release of process gases, flammable clouds can be formed, which in the worst case can explode. Such scenarios will need to be researched. In the licensing procedure it will have to be proven that a possible explosion will not damage the containment building or other safety-related parts of the nuclear plant, including the control room. Nuclear cogeneration plants will have to fulfil much higher safety requirements than dedicated electricity generating nuclear power plants. This needs to be reflected into the research strategy.

It is already covered.
Taking into account the favourable safety characteristics of HTR, the coupling of an HTR to a conventional process has to take into account the different licensing procedures and the avoidance of negative impact of the nuclear energy source and the industrial process side, and vice versa. P.73.

7. pages 13 and 77 (Cross-cutting R&D topics) : Knowledge management is essential as it allows to store and disseminate the results of research. Currently, a large fraction of research results, and associated human and financial efforts, are lost, wasted or needlessly duplicated because of poor KM. Increased efforts - and innovative imagination to define effective and efficient solutions - are absolutely required in this area.

Added to the new text.

8. page 13 and 77 (Cross-cutting R&D topics) : The same is true for Public communication of research objectives and major outcomes. Active and continuous dialogue with the public (in a broad sense, including members of Parliaments, decision-makers, opinion-formers, media, teachers, etc.) is one of the keys to understanding and acceptance of nuclear power. This area is usually neglected by researchers, with the consequence that public opinion is shaped and manipulated by propaganda more than reason. The effort described on page 19 under the title "Public and Stakeholder communication" is, in my view, insufficient because it is essentially reactive (and, therefore, piecemeal, unbalanced and on the defensive), rather than proactive, coherent, well-focused and inspiriting. In this area also, innovative imagination, making full and extensive use of contemporary communication tools, is strongly required.

Topic already addressed in the Introduction chapter.

9. page 13, lines - 5 and - 4 on the right side : I suppose that "know-why" should be "know-how"

By "know-why" we intend to refer to science and rationales.

70.
I would like to respond to your call for public consultation on the 2013 Strategic Research and Innovation Agenda.

I would like to add (as a non-specialist, but as an Architect), that I would like to see more Nuclear Physics and Engineering research funds awarded across Europe, rather than concentrated in one particular location and that the geographical diversification of funds be matched with a harmonization of the size of grants, as opposed to very large block grants being simply given to the ITER and other large projects.

As an Architect, working in the Urban and Rural realm, I would like to call for a greater emphasis on the smaller scale Thorium, Liquid Salt and Sub-critical models of Reactor that are being developed in the UK.

These smaller and less containment infrastructure intensive elements, have the opportunity to increase resilience of energy production through dispersion; localize and locate production as required, rather than remotely, and also develop local Nuclear Engineering expertise across Europe.

By funding a diversity of project, the possibility of innovation outside of the "usual suspects" is also enhanced; in particular the work of the University of Huddersfield, UK is of note, yet they do not enjoy the right amounts of funding to enable them to develop and prototype as well as their international competitors.

I thank you for your time and again ask you to diversify your funds into the newer, developing technologies outside of the usual recipients to encourage new European innovation.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

71.

After reading the draft version of the SRIA, I would like to point out one topic this is surprisingly missing in this document otherwise complete and promising. No section is dedicated to one of 6 concepts selected by the GIF, the molten salt reactors. A veiled reference is done through two sentences at the end of the section “R&D to improve sustainability of Nuclear Fuel Cycles”, and the MSR acronym is listed in the glossary.

The most important arguments in favor of including a section dedicated to the molten salt reactor technology in the SNETP Strategic Research and Innovation Agenda are the following:

- The MSR concepts currently under study and selected in the frame of the Generation IV International Forum are fast reactor concepts, as described in the annex to the SRA entitled “Molten Salt Reactor Systems” and published in January 2012.

- They are thus one of the four fast reactors selected by the GIF as complying with the generation IV criteria, with a high potential for safety (all negative temperature and void coefficients, low fissile inventory, no initial criticality reserve…) and flexibility of use.
  The fast MSRs have been recognized as a long term alternative to solid fueled fast neutron systems.

- The use of a liquid fuel has significant potential benefits:
  - The homogeneity of the fuel allows uniform combustion, thereby avoiding loading plans
  - Fuel management involves only fluid transfers
  - Reprocessing and fuel preparation require no change of state
  - In an emergency, the fuel can be transferred quickly by gravitational flow to vessels designed to evacuate the residual power passively
  - Fuel reprocessing can be done online or in batch mode on discrete samples and therefore without requiring reactor shutdown

- The fuel flexibility can be adjusted continuously if needed and adapted to breeding (with Th) or burning (without Th) of spent PWR fuels or even Minor Actinides only. It can use various fissile matters, 233U, enriched U, or Pu and MA coming from spent fuel, and is thus able to take part in many different scenarios of future nuclear deployment.

- The development of MSR also provides several cross-cutting technologies, like the use of molten salt coolants in HTR as studied in USA and the use of molten salts as energy carriers in heat transfer loops.

- Europe has expertise in the fast MSR studies, supported since 10 years by French academic programs (PACEN, NEEDS) and by the present EVOL (FP7) project in collaboration with Russia (ISTC). Other researches are in progress in the world: in Russia (for a molten salt burner) and in China (demonstrator of a thermal molten salt reactor and prospective studies of a fast MSR). A collaboration between China and DOE is in preparation. Giving up the molten salt option for Europe will lead to the disappearance of European experts and thus to a gap of knowledge that would not be filled in if needed later.

Therefore it seems wise to spare only a tiny part of the resources available to keep this kind of reactor as a possible way for the future by maintaining a European action that would preserve the European research community on fast MSR and allow a well informed decision to be later taken on this kind of reactor. This fast reactor concept seems to have fully his place in the section “ESNII FAST REACTOR SYSTEMS FOR SUSTAINABLE FUEL CYCLES” of the SNETP Strategic Research and Innovation Agenda currently under writing, following the publication in January 2012 of an annex on this topic to the previous SRA, to keep this kind of reactors in the European scope for sustainable nuclear energy.

Answer:

Thank you very much for your explanation related to the benefit of the MSR. SNETP supports long term R&D, in particular on MSR, even if the SRIA considers more short term priorities: in 2011 and 2012, SNETP has issued two annexes, one on Thorium fuel cycle and one on MSR, which are still valid even if they have not been formally integrated in this new edition of the SRIA. MSR is not a part of the ESNII which is a European Industrial Initiative devoted to a more sustainable nuclear energy but with a shorter term perspective than the MSR concept.

Nevertheless more reference to thorium fuel cycle and MSR have been introduced in the final version of the SRIA. Please also check the annex “Clarification on SNETP position on Thorium and MSR research".

72.

As someone who has been following the work of SNETP, I was very disappointed after reading the draft 2013 Strategic Research and Innovation Agenda to find that it greatly diminishes the importance of thorium fuel cycles and molten salt reactors. Indeed, the change of name for this document to include the word "Innovation" would seem to highlight the growing need to explore radically different technologies.
I urge you to reconsider and to reinstate the excellent, balanced Annexes on thorium fuel cycles and molten salt reactor systems in the 2013 Strategic Research and Innovation Agenda. I request that the 2013 SRIA includes discussion of both thermal- and fast-spectrum molten salt reactors, leading to continued and expanded research in this field and the inclusion of at least one molten salt reactor concept in the ENSII roadmap and associated "Horizon 2020" funding framework.
Given that safety and spent fuel are listed as priorities for SNETP, it is strange that thorium fuel cycles and molten salt reactors do not receive greater attention in the 2013 SRIA.
The potential benefits of thorium fuel cycles were well-documented in SNETP’s Annex. As your Annex states, fertile thorium always requires the addition of fissile driver, which is generally taken to be either highly enriched uranium (HEU) or plutonium. Thus thorium fuel, in either a solid oxide or molten salt form, would provide an excellent means of reducing European stocks of spent fuel. As SNETP’s Annex acknowledges, at a time of rising global demand for uranium, alternative fuel cycles should certainly be considered. In addition thorium, with its very high melting point, is ideally suited for High Temperature and Very High Temperature Reactors, both of which will be key to achieving SNETP’s Nuclear Cogeneration Industrial Initiative.
MSRs offer outstanding safety benefits including passive temperature regulation and a low operating pressure. The liquid fuel in an MSR can be safely drained into dump tanks at any time during operation, should it be necessary to stop the chain reaction. In addition, molten salts are very effective coolants with high heat capacity which enables excellent thermal to electrical conversion efficiency. Some MSR designs include online reprocessing of the fuel salt which enables continuous removal of fission products, resulting in high fuel burn up. Coupled with abundant thorium fuel, MSRs will produce very little high level waste, and almost no plutonium.
To pick up on a few specific parts of the draft document which I find to be of particular concern :
p10 : "With respect to the 2010 evaluation of technologies, sodium is still considered to be the reference technology since (my italics) it has more substantial technological and reactor operations feed-back" : Surely the principal metric for the evaluation of reactor technologies should be their potential to fulfil SNETP's ambitious goals?
p5 : "The safety of nuclear installations results from a permanent process of improvement" : Major safety improvements can also be obtained by adopting a new, disruptive technology.
p26 : "Although technically possible, the fuel cycle based on thorium (...) is not implemented on an industrial scale today in any European country" : It hasn't been done, therefore it can't be done?

p29 : "An interesting strategy for the long term could be the combination of Molten Salt Reactors (MSR) technologies, both with thermal and fast neutrons, with the thorium fuel cycle" : The document seems to offer no justification of why this should be a "long term" strategy.
p71 (Table 2) : Please add a line for molten salt reactors, which would be highly suitable for process heat applications.
For over forty years Europe has been the global centre for thorium and MSR research and development, with groundbreaking programmes across Europe, in France, Czech Republic, Germany, Norway, the United Kingdom, and in other countries. In the last year international interest in thorium and MSRs has been reawakened. China, India and Japan have all announced, or are poised to announce, thorium and molten salt reactor research projects. At this critical and exciting time, I urge you to reaffirm the presence of European researchers at the forefront of the research and commercialisation of thorium and MSRs.
Thorium and molten salt reactors complement existing nuclear technologies and have a clear role to play in a future nuclear energy ecosystem. The world needs a European nuclear industry that embraces innovative solutions as it continues to refine existing technologies. Now is not the time for Europe to abandon or relegate research into thorium and MSRs. Europe's nuclear researchers have the opportunity to lead the world in the development and commercialisation of a major new low-carbon energy technology, with great benefits for the world. We should not let this opportunity slip away. I hope you will agree and will reinsert thorium and molten salt reactors into the 2013 Strategic Research and Innovation Agenda.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

73.
as a german scientist, chemist with more than 30 years of experience in nuclear sciences and nuclear fuel manufacturing (NUKEM, RBU, HOBEG, ALKEM, SIEMENS-Brennelementewerk, SNR-300, VAK, CANDU), and also knowledges of the MSR-Experiment from ORNL, TN, I would like to offer you the cooperation of my engineering-office.
During the last year SNETP recognized the several advantages of MSFRs and also MSR and gave the orientation for the funding.

MSRs offer a much better energy efficiency than the conventional U-5- or MOX-driven LWR or even the CANDUs.
Furthermore they don`t produce the problems which we have in the final disposal with minor-actinides. After nearly 300 years of disposal the radiation reaches the level of the environmental background radiation.
Being guided by the ORNL materials tests, during the past year you studied also the Ni-W-Cr- alloys, which still will have to be tested in hot fluoride salt (FLIBE or LiF, ZrF4, UF4).
Good experiences with modified Hastelloy N has already been made at ORNL during the beginning seventees of the last century.
Therefore I would like to propose the combination of your new results with W with the former good experiences.
We should exchange Mo by W, reduce the Cr-content a little bit (to reduce the micro-cracking), and introduce also small amounts of Ti.
You find the good results of the modified Hastelloy N plus Ti in the "MSR-Program Semi-annual Progress-Report Aug 1971, ORNL-4728.
To achieve these goals we should take the opportunity for further intensive investigations in structure-materials!
However the latest draft of the 2013 SRA removes almost all discussion of molten salt reactor systems!
You should not destroy the chances which MSFRs or MSBR might offer for the future energy-, process-heat- and nuclide-generation.
We should also have in mind that the process in a MSR needs no severe pressure as in our PWRs. Therefore the costs for building and also maintenance will be much less.
Furthermore a MSFR will have not much U-enrichment- no nuclear-fuel-manufacturing- and less costs for final disposal!

Because of these severe circumstances I would like to demand you for the Re-Instatement of MSR and Thorium annexes.

We should use the chance for the further development of the great work of the former ORNL-staff.

Moreover I would like to give you another hint for testing siliconcarbide and their derivatives.
I made not only a lot of literature research and did find out that this compound-material offers high radiation resistance.
Therefore I would like to recommend you for further investigations of these materials.
In a special email I can inform you about my developments of the A3-graphit-matrix which has been used in the nuclear-fuel-elements for the AVR and THTR.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

74.
First, even though I have not read the entire document proposed for debate, I appreciate the importance of this document. Therefore I want to congratulate those who have worked for the elaboration of this document.

On the other hand, last year, I read carefully document no. 17933/11 “Proposal for a Regulation of the European Parliament and the Council establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)”, where at page 32 were underline the next:
“Europe has set out its ambition to move to a new economic model based on smart, sustainable and inclusive growth. This type of transformation will need more than incremental improvements to current technologies. It will require much higher capacity for science-based innovation fuelled by radical new knowledge, allowing Europe to take a leading role in creating the technological paradigm shifts which will be the key drivers of productivity growth, competitiveness, wealth and social progress in the future. Such paradigm shifts have historically tended to originate from the public-sector science base before going on to lay the foundations for whole new industries and sectors.
World-leading innovation is closely associated with excellent science. Once the undisputed leader, Europe has fallen behind in the race to produce the very best cutting-edge science and has played a secondary role to the United States of America in the major post-war technological advances. Although the Union remains the largest producer of scientific publications in the world, the United States of America produces twice as many of the most influential papers (the top 1% by citation count). Similarly, international university rankings show that US universities dominate the top places. And 70% of the world’s Nobel Prize winners are based in the USA.
One part of the challenge is that, while Europe and the United States of America invest similar amounts in their public-sector science bases, the Union has nearly three times as many public-sector researchers, resulting in significantly lower investment per researcher.
Moreover, US funding is more selective about allocating resources to the leading researchers.
This helps to explain why the Union’s public-sector researchers are, on average, less productive and, altogether, make less combined scientific impact than their far less numerous US counterparts.”

When discussing prototypes of Generation IV nuclear reactors actually discussing not only the excellent scientist talk, plus about technology excellence. Therefore I think it is good to see and what makes USA for nuclear power reactors and Generation IV.

Last year I was Coordinator Officer at the 4th AIEA Vienna RW&SFM Convention and I reed more about Nuclear Energy Policy of USA, and not only. In the Report for USA I resumed next1:
“Energy Policy Act 2005
After much preliminary debate, the Energy Policy Act 2005 comfortably passed both houses (74-26 in the Senate and 275-156 in the House). It included incentives for the nuclear power industry, including:

- Production tax credit of 2.1 ¢/kWh from the first 6,000 MWe of new nuclear capacity in their first eight years of operation (the same rate as available to wind power on an unlimited basis).
- Federal risk insurance of $2 billion to cover regulatory delays in full-power operation of the first six advanced new plants.
- Rationalized tax on decommissioning funds (some reduced).
- Federal loan guarantees for advanced nuclear reactors or other emission-free technologies up to 80% of the project cost.
- Extension for 20 years of the Price Anderson Act for nuclear liability protection.
- Support for advanced nuclear technology.

Also $1.25 billion it was authorized for an advanced high-temperature reactor (Next Generation Nuclear Plant) to be built by 2021 to be built at the Idaho National Laboratory, capable of co generating hydrogen. Overall more than $2 billion was provided for hydrogen demonstration projects

Also it is to mention that USA has very ambitions programs for new NPPs, around 26.000 MWe till 2020 – 2025 that underline more the challenges for final disposal of SF&RW in next period.
1World Nuclear Association, http://worl-nuclear.org/info/ inf41_US_nuclear _power_policyhtml
I consider that it was necessary the above introduction for the following proposals:

- The document should have 2-3 paragraphs dedicated to promoting international practice Generation IV reactors, USA, Japan, Russia, or Another;
- To prototype and demonstrate their competitiveness is important to differentiate financial needs for research support (including for conducting experiments) at the investments themselves. Personally I believe that many research activities support would fit and would be eligible for Horizon 2020;
- Financial aspects are treated partly why I think should be a chapter. That's why I gave the example USA. To demonstrate those prototypes the EU should think at least some aid schemes also, if not direct financing. Generation IV reactors stake is not only extend the life of uranium resources, but also reduce the volume of radioactive waste.
- In terms of human resource, see page 38/82, it should not be limited only to government agencies. For all that is proposed in this document is very important to have nuclear expertise at government level, especially ministries, but including the European Commission also. If we take in consideration only life time of the Generation II and III of nuclear reactors, the RW&SFM and Decommissioning activities, we need human resources for more than 100 years at the whole levels of society.
- Also I didn't notice some difference, in safety vision, between the less development countries with small nuclear energy program and the development countries with large nuclear energy program. At least from financial point of view it is obvious that small nuclear program have fewer resources to finance the objectives of Strategic Research and Innovation Agenda.

Answer:

"Thank you very much for your comment and especially on the considerations related to Horizon 2020 document.

SNETP can share most of your comments in particular on the USA initiatives which support the development of new reactor technologies. Today and in particular in Horizon 2020 – Euratom programme, Europe does not seem to go in the same direction.

Nevertheless, your proposals are not in the scope of a document like the SRIA, as SRIA as such does not deal with financing, and should be more effectively forwarded to the European Parliament, Commission and to the Member States representatives for the on-going discussion on Horizon 2020."

75.
I am concerned by the low priority given to thorium research in the current draft consultation on sustainable nuclear energy, especially following the supportive report published in January 2011. While it is true that thorium reactors are not currently used industrially, serious research seems to be gathering pace in India and China and it would be regrettable if we in Europe were left behind on this technology, which promises much cheaper (and locally available) nuclear fuel than uranium based reactors, and reactors which could be smaller and produce less dangerous waste than those we currently construct. Unlike fusion, it seems well accepted that a thorium reactor can be made to work on an industrial scale - it is merely a matter of development and research, which is only lacking because uranium reactors have historically been preferred for reasons more connected to the Cold War than to public safety and energy security.
I would recommend that a higher priority be given to thorium research than is currently being suggested.

Please check the annex "Clarification on SNETP position on Thorium and MSR research".

76.
I consider it imperative that the possibilities of thorium energy be explored to maximum potential.
Please review your priorities.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

77.

First of all I would like to congratulate the authors with this excellent job done! It has become a very clear document.

I have only a few serious remarks on the report. In general the focus is very much on the uranium-plutonium fuel cycle and on the recycling of plutonium and minor actinides in fast reactors, while we have also available the use of thorium in MSR as a long-term option for nuclear energy parallel to the development of fusion energy. For a Technology Platform focusing on sustainability, the use of thorium, which produces much less plutonium and minor actinides to begin with, could deserve some more attention. I therefore included here and there some supplementary lines and modified a few sentences to focus a bit more on thorium and MSR. I hope you are willing to include these minor changes to get a better balance in the document. You can find my changes on pages 6, 7, 12, 26, 27, 74

Besides the changes indicated on these pages, I would also favour some more attention to Small and Medium-sized Reactors as a possible option to overcome the safety issues we’ve seen with Fukushima. Among the SMR I would also like to include the HTR, which now is mainly included under the pillar of Cogeneration.

- P.6: Three issues: Optimum use of natural ressources, nuclear waste recycling and minimization of nuclear waste production

Taken into account in the final text.

- P. 6: When using uranium these breeder reactors need to have a fast neutron spectrum, while also thermal breeder reactors can be designed with thorium.

Included in the final text.

- P.7: The technologies of thorium in MSR including new materials, salt chemistry, thermal-hydraulics, simulation tools, and nuclear data.

Too much detail for the suggested text position.

- P.12: alternative fuel cycles, including thorium, to conserve fuel resources, minimize waste and optimize cycle length

Included in the final text.

- P.26: The optimization of natural resources, to maximize the electricity obtained per unit of uranium, or thorium, mined, is progressively

Not included

- P.26: Therefore it must be underlined that “breeder” reactors, but also thermal and fast MSR using thorium

Taken into account in the final text.

- P.27: fleet of fast neutron spectrum critical reactors that simultaneously produce electricity and transmute all the actinides. The only input into the system (reactors and fuel cycle facilities) is natural or depleted uranium, or in case of MSR, thorium

Not included

- P.74: alternative fuel cycles to stretch fuel resources, to minimize waste and to optimize cycle length: cf. related SRA section on Fuel Cycles (and the use of the thorium fuel cycle)

Not included

Answer:

Thank you very much for your comments and your proposals on the present draft of the SRIA.

For the final version of the SRIA, SNETP has included most of your proposals for modification.

More generally, the SRIA focusses on the short and midterm R&D objectives but it supports also longer term R&D: the two documents issued in 2011 and 2012 on thorium fuel cycle and on MSR are still valid and have been explicitly referred in the SRIA. Please also check the annex “Clarification on SNETP position on Thorium and MSR research".

78.

I would like to suggest that the question of funding for the UK thorium research program is added to the agenda. This should be in parallel with other countries research funding and efforts, we should not at this early stage concentrate on one avenue only.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

79.
Just as China, Japan, India, Russia, Norway, and the US Academy of Sciences hone in on the tantalizing prospect of safe, clean, and ultimately cheap energy from thorium nuclear reactors, the Europeans seem to be going in the opposite direction. I refer. of Course to the potential of Thorium based nuclear power.

Please ensure that Thorium research is funded on a par with other energy sources.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

80.
Although I am no fan of nuclear fission of any kind, it seems to me that research into Thorium based reactors paves the way towards making this industry safer and cleaner, with weaponizing possibilities also being removed. I also believe that the interests of uranium mining companies should be marginalized ahead of the safety concerns of Europe’s population.
Please include thorium based solutions in your forthcoming document. They may not be an answer, but they are a more peaceful way of implementing nuclear power as part of Europe’s strategy

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

81.
You should be investing the majority of funding into researching nuclear energy from Thorium.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

82.
In response to the SNETP public consultation on Strategic Research & Innovation Agenda, I would strongly suggest that more support and funding be given to those R&D programmes which involve the use of thorium as a fuel. To investigate optimum reactor design for thorium, in particular the work on accelerator driven subcritical reactors being investigated at the University of Huddersfield in the UK.

SNETP's own report on the thorium topic was extremely positive and as such should be justification enough to ensure adequate funding to the above UK university's research programme. After all, such thorium R&D programmes are being heavily funded outside of the EU. The EU should not fall behind in these ventures.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

83.
Uranium technology is obsolete and creates toxic waste. ‘Renewable’ energy creates more problems than it solves and needs to be backed up 100% by conventional power stations.
China, Japan, India, Russia, Norway, and the USA are investing in Thorium nuclear reactor research with a view to producing safe, clean and ultimately cheap energy. Why is the EU not doing the same?
Why is EU funding into energy concentrating solely on Uranium technology?
It is time to concentrate funding on what is best for the general population rather than concentrating on vested interests in France.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

84.
With regards to the above publication, I draw your attention to the following paragraph from the documents Executive Summary:

“The primary priority and responsibility in front of European citizens for the nuclear energy sector is, of course, nuclear safety. The Fukushima accident increased public concern about nuclear energy and drew renewed attention to the safety of nuclear power plants. “

With safety in mind, can I ask why the above document seems heavily geared towards the public financing of Uranium Nuclear Powered Reactors, when Uranium is less stable, more environmentally damaging and was the fuel that caused Fukushima when there is a safer, more environmentally friendly nuclear fuel source available in the form of Thorium?

I understand that the French Nuclear Industry have a great deal of capital invested in Uranium, including providing the raw material, but, either this consultation is about providing safe nuclear power from the safest cleanest nuclear fuel sources or it is not.

The rest of the world are concentrating their efforts on Thorium powered Nuclear Reactors as all the evidence suggests that Thorium is safer and more environmentally friendly.

It disheartens me, that the European Union seem destined to spend many Billions of European taxpayers funds protecting a European Nuclear programme that concentrates almost entirely on Uranium, which isn’t the safest solution, but does however protect the French Nuclear Energy Industry if not the safety of the citizens of Europe.

Safe, reliable and clean Nuclear Energy will soon be available to the world. The rest of the world have embraced Thorium.

I disheartens me that the European Union seem destined to pursue Uranium, whilst using “safety” as part of their argument. If your consultation document was about safety, then surely, the EU like the rest of the world would be committing research funding into nuclear fuels that are both efficient and safe and that research would not be centred on Uranium, which can be converted into weapon grade material and will stay radio active for many THOUSANDS of years.

I don’t wish my taxes to be spent on researching Uranium Nuclear Reactors, when a safer alternative has already been identified and that alternative (Thorium) cannot be converted into a nuclear weapon.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

85.

The Agenda needs to include far more discursive and supportive text with regard to experimentation and support of alternative projects into nuclear power solutions other than that of the uranium. One such example being that of the molten salt thorium. At a time when most people in the U.K. are rapidly turning away from support of the European model in nearly all forms it would heartening to see funding being made available to people such as Bob Cywinski and Roger Barlow at Huddersfield University and their work on such an accelerator driven subcritical reactor. It concerns many to hear that there is no funding available within Europe, from which one can only conclude that this is yet another avenue of development that the U.K. government would be better geared to divert funds to rather than subsidising the European project.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

86.

I agree with Ambrose Evans Pritchard of the UK newspaper Daily Telegraph. We need to invest some money on research and development of thorium energy and not place all our eggs in conventional nuclear (uranium, plutonium) research.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

87.

Last year you published a glowing report on thorium fuel cycles (http://www.snetp.eu/www/snetp/images/stories/Docs-SRA2009/sraannex3final.pdf),

as well as a separate study on molten salt thorium reactors, though one entirely focused on the specific French technology at Grenoble rather than other equally compelling variants.

Why have you changed their tune over the last year?

Obviously, France will always be part of a next-generation energy strategy but Britain has excellent nuclear physicists. A team under Professors Bob Cywinski and Roger Barlow at Huddersfield University are working on an accelerator driven subcritical reactor that would be very safe.

There could be no Fukushima chain reaction or meltdown with their reactor because the thorium fuel has to be bombarded with neutrons to keep the process going. The moment there is trouble, you simply switch off the beam.

They need £100m or so for a three- to four-year programme to build the base of a subcritical reactor. They are talking to teams all over the world, including Fermilab in Chicago. But there is no funding in Europe.

Surely some funding should go towards this, if not then it may be time for Britain to repatriate its scientific research funding from the EU as well as all the other powers we have handed over so money and skills could be lavished on France.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

88.

I have examined the current draft of the 2013 SNETP Strategic Research and Innovation Agenda for the “European Sustainable Nuclear Energy Technology Platform (SNETP)”

The document has 82 pages in double column. However, I find that the most important nuclear energy technology for the future is only mentioned in page 82 in a short paragraph of just 88 words.

The Thorium Molten Salt Reactor (ThMSR) is the most promising technology of the GenIV agenda.
Why?
1.- It is the only technology that may bring nuclear energy to compete in PRICE with coal and hence be widely adopted worldwide. The reason for that fact is contained below.
2.- Greatest simplicity (No fuel rods to be manufactured, no complicated reactor core)
3.- Low pressure reactor core without a large FLANGE for periodically opening and reordering or exchanging spent fuel rods.
4.- The low pressure in the core makes it virtually impossible to have a major accident.
5.- Reactor core meltdown is a senseless concept in a MSR
6.- Molten salt fuel does not suffer radiation damage so it stays in the reactor the whole life of the reactor (30 + years)
7- Potentially100% utilization of contained energy in the fuel compared to about 1% in once-through usage in PWR.
8.- Operation at high temperatures in excess of 700o C for higher thermodynamic efficiency in the production of electricity or other thermal uses.
9.- Elimination of the accumulation of nuclear fuel waste in used fuel cooling pools.
10.- Considerable simplification and cost reduction of fuel reprocessing.
11.- The MSR can be small, very simple and very safe. Hence they will be easy to deploy in third world countries which don’t have the large capital needed for present day PWR.
12.- If burning thorium, MSR will produce a fraction of actinides compared with solid fuel uranium reactors and hence, by not producing Plutonium, they will be the most desirable from the WASTE and weapons PROLIFERATION point of view.
13.- Thorium is plentiful worldwide and obtainable in many third world countries. Hence it will be easier to be adopted at those countries.
14.- MSR can accept a variety of fuels: They can burn U233, U235 and Pu239. In fact they can burn a mixture of actinides recovered from their own operation or recovered from current PWR nuclear waste or Pu239 recovered from dismantling nuclear weapons. Hence MSR can serve to clean the world of noxious long lived or dangerous nuclear material.

15.- Gaseous fission products are removed during MSR operation by the injection of helium. This removes the reactor poison gas Xe135 so that the reactor does not suffer from “Xenon Poisoning” which prevents changing reactor power in solid fueled power reactors and current PWR. Due to this property a MSR can follow the electrical power demand over a wide margin.
16.- MSR are the ideal complementary power supply for renewable energy sources which are intermittent in operation as MSR can operate on low power during high wind or large sunlight supply hours and operate on high power during low wind or darkness.
17.- Thorium MSR can operate in a fast neutron spectrum or in a slow neutron spectrum allowing for development of both of these technologies leading to a best solution out of the natural technological competition.
18.- An accelerator molten salt breeder (AMSB) is the best option for the production of fissile fuel in the future thanks to the neutron-rich spallation reaction. AMSB could be used with uranium to produce Pu239 fissile or with thorium to produce U233 fissile. The fuel produced could be used for PWR or in MSR. This procedure is the only technology currently considered which could have a doubling time short enough to supply present growth of world energy demand.

All of these claims are soundly supported by a lot of research done in the USA and elsewhere during the 1960 and 1970 decades and during the last years. This pool of knowledge is now widely and openly available in the INTERNET. If you have questions I suggest you examine the paper K. Furukawa, et al.(2012) Available in <http://j.mp/s4yNYh>

I work in a nuclear research laboratory at a University in Caracas, Venezuela, a country well known for its high oil production. We recognize that nuclear is the energy of the future and we want to maintain our energy independence. For that purpose we are involved in creating in our laboratory a liquid fuel zero-power thorium sub critical assembly that will operate at room temperature. It will be devoted to research and education. We will train there the human resources, the future nuclear engineers that will work in MSRs.

The thorium MSR is a technological proposal with so many advantages over current solid fueled uranium reactors that it can be compared to the advance that flat-plate computer monitors and televisions had on the previous CRT monitors, or the advance of digital photography over the previous film photography.

Please do a favor to the EU community and to people like us in third world countries, and include some, or all of the pervious arguments in the 2013 SNETP Strategic Research and Innovation Agenda.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

89.
This is a comment directed towards the SNETP Document's incorrect description for the utility and development of thorium based fuels. In the document it currently states "there are no short or medium term industrial prospects in Europe for the development of the thorium cycle." This statement should be reversed for the reasons I describe next.

Currently a Norwegian based company known as Thor Energy AS, which i a affiliated with, is deeply involved in the development and testing of thorium based light water reactor fuels. Thor Energy has done extensive experimentation to develop proper mixed-oxide fuel ceramics for light water reactors and is beginning an extensive irradiation test of these fuels in the OECD Halden test reactor. The irradiation which will beginning this month (January 2013) is expected to test a series of both plutonium-thorium mixed oxide fuels and uranium-thorium based mixed oxide fuels. The irradiation testing will last 4-5 years in which time the necessary data will be collected to ultimately support a final goal of licensing this fuel.

We at Thor Energy believe in utilizing Thorium as the basis fertile component for a mixed oxide fuel for many reasons. The combination of plutonium and thorium to form a Th-MOX fuel is an attractive way to incinerate RG and WG plutonium. The irradiation of Th-MOX results in a spent reactor fuel with lower radiotoxicity and lower plutonium levels. Furthermore, thorium oxide is highly inert and cannot be oxidized beyond its +4 oxidation state (unlike UO2 which easily oxidizes to U3O8). Thorium oxide is also much less soluble in aqueous media. As a result of the aforementioned, thorium oxide provides safety benefits in abnormal reactor operation and added safety margins in waste management and spent fuel storage. Thorium dioxide also has a

higher thermal conductivity than uranium oxide and due to a higher degree of oxide stability thorium fuels releases less fission gas. The higher absorption cross-section and the reduced fast fission factor of thorium coupled with the flatter spectrum dependent neutron yield of uranium-233 allows more plutonium to be loaded into the fuel pins while still maintaining adequate safety margins and negative reactivity coefficients. Lastly, the net plutonium destruction for thorium based fuels is roughly 50 - 70 percent, vastly exceeding that of uranium based fuels.

Lastly, we are saddened to see that the optimistic tone for Thorium fuels and Thorium based fuel systems in the SNETP document has drastically diminished from last years publication. Thorium provides a short term means to begin to reconfigure the utility of many fuel forms towards a safer and more reliable standard. It also holds a means to alleviate decades of political and public concern through its benefits, which are concerns that should be upheld and supported by the SNETP document. We, among many others, would prefer SNETP to continue to take a favourable and supportive role in the development of thorium based reactor systems.

Answer:

Thank you very much for your detailed comment.

SNETP appreciate your explanation on the Thor Energy AS plan for the development of a Thorium based fuel. In the short and medium term, SNETP is nevertheless not aware of utilities in Europe ready to commit themselves on thorium based fuel procurement.

The SNETP publications on 2011 and 2012 on thorium fuel cycle and MSR, are still in force and are now referred in the final version of the SRIA. SNETP considers that, on the longer term, these developments are very promising. Please check the annex “Clarification on SNETP position on Thorium and MSR research".

90.

My name is Ritsuo Yoshioka, and I am a president of International Molten-Salt Forum (ITMSF), which is composed of researchers and engineers who are involving in the R&D of Molten Salt Reactor (MSR) and related thorium cycles from 11-countries in the world.
(USA, Russia, Czech, France, Venezuela, Turkey, Canada, China, Ukraine, England, and Japan)
Today, I received a very surprising information that the SNETP draft Strategic Research Agenda 2013 removed the most important part on MSR and thorium cycle, which was shown in 2012 version and http://www.snetp.eu/www/snetp/images/stories/Docs-SRA2012/sra_annex-MSRS.pdf>)
Since your dead-line of acceptance from the public is tomorrow, I have no time to ask my colleagues or our Forum members to send the same opinion.
But, I believe all our Forum members agree my opinion.
As you may recognize, China has started Thorium-MSR program in 2011, and now 400-people are working to build the first MSR in coming 5-years.
India has a long history of thorium on solid-fuel reactor, and they started MSR program in 2012.
Other Asian countries including Japan have strong interest, and just starting R&D program.
Since you issued MSR part in 2012, you already recognized that European countries such as France, Czech and Russia have been developing MSR and related thorium cycle for the last 10-years, and still going on.
I visited IAEA in last October, and I found IAEA has a strong interest in thorium cycles.
And, of course, USA has a longest history on MSR.
If you need more details, I can explain later.
So, again, We strongly request you to bring back the portion of MSR and thorium cycle to the 2013 version.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

91.

It was a great pleasure to review the update of the SRIA and to compare it with the previous version.

May I suggest the addition of more liquid fuel-related research? The world-class research going on about Molten Salt Reactors at Grenoble, Delft and Rez should be given the opportunity to compete with the Chinese project that you are surely aware of.

The unique possibility of being able to dump the core for DHR should be worth more consideration after Fukushima, yet the 2009 version of the SRIA puts liquid fuel technology in a similarly undefined distant future as the one under review now.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

92.

Since SNETP has launched an update of its SRIA document and is seeking suggestions from the general public, I direct your attention to two very nuclear technologies that in my opinion deserve top place in any document about sustainable nuclear future.

The first is the Molten Salt Reactor (MSR), and particluarly the Liquid Fluoride Thorium Reactor (LFTR) design, outlined in the July 2010 issue of Scientific American (Available here in .pdf).

The second is the Intergral Fast Reactor (IFR), a successor to successful American EBR-II breeder reactor. S-PRISM (from SuperPRISM), is the name of a commercial nuclear power plant design by GE Hitachi Nuclear Energy based on the IFR. In 2001, as part of the Generation IV roadmap, the DOE tasked a 242 person team of scientists from DOE, UC Berkeley, MIT, Stanford, ANL, LLNL, Toshiba, Westinghouse, Duke, EPRI, and other institutions to evaluate 19 of the best reactor designs on 27 different criteria. The IFR ranked #1 in their study which was released April 9, 2002.

Please check the annex “Clarification on SNETP position on Thorium and MSR research".

93.

P. 51: ESNII-systems shall be designed to use as much as possible passive safety systems and inherent safety characteristics.

If you mention this, you implicitely say that passive and inherent safety characteristics are the key to improvement of safety.
Implicitely, you immediately disqualify a system like EPR which to my opinion has significant safety features. It will be better to make the statement more generic. The statement 'ESNII-systems shall implement a safety approach based on the most recent standards and best international practices, using the experience gained from past and present nuclear science and engineering' already captures this.

P. 51: ESNII-systems shall aim at further improving economic competiveness and operability of nuclear energy in a future European energy mix

ESNII systems to my opinion will need many many years in order to achieve the same level of economic performance as LWRs if they achieve this at all. The most important aspects of ESNII systems should be more efficient use of resources and minimization of waste. It is normal to pay a price for this. Therefore, I propose to change the statement to:
'ESNII-systems shall aim at economic competitiveness with other nuclear energy productions systems'

P. 51: The main objective of ESNII is to keep European leadership in fast spectrum reactor technologies that will excel in safety and will be able to prepare a more sustainable development of nuclear energy.

It should never be the main objective to keep leadership! It is even debatable if Europe can be considered as leader at all! The main objective should be increase the sustainability of the European nuclear fuel cycle by using natural resources more efficiently and by minimizing nuclear waste.

P. 54: JHR is mentioned. Add PALLAS and MYRRHA.

P. 60: For MYRRHA a thermal-hydraulics programme is mentioned. To my opinion this should be relevant also to ASTRID and ALFRED. Therefore, I would like to mention somewhere in the ESNII chapter that there is a generic (cross-cutting) need for a thermal-hydraulics program for liquid metal cooled reactors focussed e.g. on the subjects mentioned in the MYRRHA chapter i.e. fuel assemblies, core (including control and safety rods), reactor pool, and spallation target (for MYRRHA).

P. 60: A very important aspect of a fuel qualification is to have available a material test reactor in which you can perform this fuel qualification. I think this should be mentioned.

Answer: p.51 Rewording has been introduced in the final text to avoid potential suggested confusions.

p.54: The statement is not a list of research reactors but un example where the indicated norm is "at present" being applied.

p.60: Maximum synergies between the different Liquid Metal Reactor technologies will be exploited for instance in the field of instrumentation and thermal-hydraulics. See page 52.

94.

Document with many format and technical changes (Member of SNETP)

Almost all the comments were taken into account.

Annex:

Clarification of the SNETP position on Thorium and Molten Salt Reactors research

In response to a number of questions and comments arising during the public consultation of the SRIA, we would like to clarify the position and support of SNETP to thorium and Molten Salt Reactors (MSR) research. First we would like to expresses our pleasure for the attention that the SRIA proposal has received and our gratitude to all the people sending their comments and suggestions. We have tried to incorporate in the best possible way all these suggestions and we believe that this has allowed us to improve the final SRIA document.

In particular, for the topics related to research for the thorium based fuel cycle and for the development of molten salt reactors, we have included some new paragraphs in the Executive Summary, and in the Introduction and Fuel Cycle chapters, to further clarify the interest of basic R&D activities in these technologies as potential long term option for sustainable fuel cycles, and to confirm the validity of the visions expressed in the corresponding annexes of the original SRA. Furthermore, several other modifications have been included throughout the whole SRIA document to explicitly include a reference to thorium when and where applicable.

As the objectives and limitations of the SRIA document do not allow us to include too many details about these topics of research, we would like to include here some general comments to clarify the SNETP position on Thorium fuel cycle and Molten Salt Reactors research.

SNETP has recently adopted its position on Thorium and Molten Salt Reactors research on the basis of two documents, prepared as annexes to its current Strategic Research Agenda (SRA):

- SRA – Annex: Thorium cycles and Thorium as a nuclear fuel component (January 2011)(link), and
- SRA – Annex: Molten Salt Reactor Systems (January 2012) (link).

These documents describe the present position of SNETP, are available from the page "Strategic Documents" of the SNETP website, and are supported by the new Strategic Research and Innovation Agenda. These documents show the significant long-term potentialities, the serious challenges to achieving industrial implementation of these systems, and the associated R&D needs and priorities.

Futhermore, during the preparation of the SRIA it was decided that it was important to focus the 2013 update of the SRIA on the R&D needs and priorities that had to be performed at short and medium term. Longer-term topics, described in less detail in this update, are not less important. Indeed, the SNETP's Strategic Research and Innovation Agenda is conceived as a living document and will continue to be periodically reviewed and updated. In addition, the SRIA takes into account that development of nuclear technology with the target to be widely deployed needs to be pursued step by step, to allow achieving the highest safety level, and to efficiently and responsibly use the very large investments and other resources required, from conception to demonstration of any new reactor or fuel cycle technology.

The Thorium Fuel Cycle

The Thorium Cycle annex reminds that thorium as a nuclear fuel component has attracted interest since the dawn of nuclear power. The main reason for the early interest was that breeding nuclear fuel cycles were expected to become a requirement for the expansion of nuclear power foreseen at the time. In this respect, the Th-^{233}U-cycle could offer the advantage that breeding may, in theory, be achieved in thermal spectra. However, even though breeding can be shown in experiments, it has proved challenging to achieve it in a commercial reactor of thermal spectrum.

There have been proposals for using thorium for other reasons. The document describes the present understanding of opportunities, limitations and challenges of applications oriented to: natural uranium saving, ThO_2 properties as matrix for the direct disposal of nuclear waste, and for Pu-burning.

The document also describes the potentialities and difficulties of using thorium fuel in different reactors, including LWR, HWR, HTR, FR, MSR and ADS, as well as the present development status of reprocessing thorium based fuels. It seems that the closing of the thorium cycle requires development of either HWR including reprocessing facilities and active fuel manufacturing and handling processes or MSR including online

separation technology. In addition, it is indicated that the expected proliferation resistance of the thorium fuel cycle will be comparable to that of the U/Pu fuel cycle.

The potential development of a closed thorium fuel cycle faces some obstacles. Reprocessing is one; remote controlled fuel manufacturing is another. Provided these can be overcome and that appropriated new reactors are developed in parallel, nuclear power via the thorium route may become sustainable. In this sense, the closed thorium fuel cycle represents an alternative option for long-term nuclear development, and therefore R&D to evaluate its feasibility and to clarify the performance to be expected in industrial implementation should be supported.

The Molten Salt Reactor

The annex on Molten Salt Reactors, MSR, highlights the potential of recent conceptual developments on fast neutron spectrum molten salt reactors (MSFRs) using fluoride salts. MSFRs open promising possibilities to exploit the thorium cycle and to contribute to significantly diminishing the radiotoxic inventory from the spent fuels of present reactors, in particular by lowering the masses of transuranium elements, similarly to transmutation proposals based on fast reactors and ADS using fuel based on uranium, plutonium or inert matrices.

Nevertheless, specific technological challenges must still be addressed and a safety approach must be established before these MSFR reactors can become a reality. As a consequence, the annex discusses the R&D needed on: structural materials, fuel salt chemistry and properties, fuel salt clean-up, and system design, operation and safety. The document includes a planning, based on the Generation IV MSFR Master Plan, aiming at establishing the viability of the Molten Salt Fast Reactor by 2018 and at optimizing its design features as well as its operating parameters by 2030. The general conclusion is that the Molten Salt Fast-neutron Reactor (MSFR), if proved feasible, could be a promising long-term alternative to solid-fuelled fast neutron reactors, well suited specifically for a closed thorium fuel cycle.

Summarizing

The SNETP Annexes on thorium and molten salt reactors show that both offer attractive potential characteristics, but at the same time involve significant technological uncertainties and challenges.

More recently, in an article published by the Royal Society of Chemistry of the UK in the issue of August 2012, Dr. K. Hesketh (Senior Fellow in Reactor Physics at the National Nuclear Laboratory of UK) underlines both the promising characteristics of the thorium cycle but also the very large technical difficulties for its implementation, the need of very long research & development programmes consuming large amount of resources before its feasibility and advantages can be clearly assessed.

Similarly, Dr. T. Dujardin (Acting Deputy Director General, Deputy Director for Science &vDevelopment of the OECD Nuclear Energy Agency) in a recent presentation to the European Parliament (Potentials and challenges of Thorium for large-scale nuclear energy production, September 2012 in Strasbourg), after acknowledging the theoretical potentialities of the Thorium cycle, indicates that R&D over the past 15 years on thorium has arrived at some strong conclusions. These conclusions indicate concerns for the feasibility of thorium fuelled breeder concepts in thermal spectrum and significant challenges to make fast thorium breeder concepts and associated fuel cycle facilities viable and competitive versus uranium fuelled fast breeders. His presentation also highlights that some of the potential advantages of the thorium fuel cycle could not reach its theoretical limits by the necessary transition period where the initial ^{233}U inventory has to be prepared using fuel containing uranium or plutonium. On the other hand, the presentation confirms that thorium can play a role in future nuclear energy systems through symbiotic scenarios, and that very significant R&D is still needed.

Both recent reviews, confirm the position contained in the SNETP documents. In fact, thorium-based fuels could be a possible way of prolonging operation of existing NPPs while easing uranium demand and producing ^{233}U. In the future, thorium could be used in the form of solid fuel in the same type of fast reactors proposed for the fully closed U/Pu fuel cycle, to develop a sustainable Th-^{233}U fuel cycle. In a even later future, Fast Spectrum Molten Salt Reactors using liquid fuel could be considered as an ultimate goal. In addition, a multitude of other transition scenarios depending on national needs and resources, fissile inventories available, existence of reprocessing industrial facilities could be considered. So thorium could be a long-term option and it should be kept open insofar it represents an interesting complement to the uranium option to strengthen the

sustainability of nuclear energy. In this sense, it is important that at least a level of research and development is supported to enable clarification of feasibility, precision of potential performance, benefits and drawbacks and contribution to the international initiatives that could materialize inside or outside Europe. All forms of support can be useful, for example from the promotion of basic research excellence in Europe, but explicit support from the most interested EU Member States could be especially effective.

On the other hand, it should be clarified that the SRIA intends to describe R&D needs, taking into account the priorities and time when the R&D results are needed, as well as the current reality of very limited resources to perform this R&D. However, the final implementation of this Agenda and the corresponding budget or resource allocation is beyond the scope of the SRIA and stays on the hands of the SNETP members and funding agencies like the European Commission or those of the different EU Member States.