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Dear Marianne Ekdahl,

Thank you for your letter. I find the letter encouraging and see it as a big step forward for ESS Scandinavia who has a well documented history of not answering inconvenient questions, boycotting critical seminars and generally not being willing to participate in a dialogue with the public regarding the controversial, environmentally hazardous and expensive ESS project.

In this letter, I would like to reflect on your comments on my presentation at Skåne Social Forum, 21 October 2007. I thank you for giving me an opportunity to do so.

YOUR COMMENT: *(1) The costs you quote are early estimate from 2003. We have been working hard to define them more accordingly. Our best estimates after a 4-year study are 1377M€ for total capital costs and 93 M€ p.a. for operating costs.*

Since the first report on ESS, which was published in 1996, at least 10 cost scenarios have been published. Most of them refer to a full ESS implementation, i.e. two target stations and 44 instruments in operation. As you know, ESS is a site independent project. Although ESS in Lund is currently based on only a long pulse neutron source and 22 instruments, the project is a staged project whose level of implementation ultimately depends on its funding prospects. A decision to build only a long pulse ESS with half the instruments is in reality a non-decision if it not is followed by a decision not to build all of the instruments. This decision has not been made. ESS Scandinavia has never concealed the fact that the consortium opts for full implementation of the instruments, if it is feasible[1]. Hence, the description of the full implementation of ESS is necessary for a correct picture of the project. Although the project temporarily has been cut in half, it is still marketed as possessing the same benefits as the full project. Furthermore, a staged implementation of the project

[1] E.g. see Allan Larsson, *Svenskt värdskap för ESS*, juni 2005, p. 84 and *the ESS Scandinavian proposal*, p. 2, which states that "ESS Scandinavia proposes that the cost savings on the accelerator is used for increasing the number of instruments. As the number of additional instruments is variable, and all instruments must not be built from day one, the total costs can be made not to exceed those of the basic design", the "basic design" meaning the design described in the *The ESS Project, Volume III Update Report*, http://www.ess-scandinavia.org/new/source/dokumentation/ESSproposal060201.pdf

carried out this way is probably the only way that the public reservations concerning the viability of the fully implemented ESS can be avoided[2]. For tactical and strategic reasons, promotion of the full project is not economically feasible at this point in time. It has to be done bit by bit.

The scenario I refer to in my presentation (slide 4) is described in the report *The ESS Project, Volume III Update Report,* which contains the ESS organisation's probably most comprehensive analysis of the costs of the ESS project[3]. The report is a part of *The ESS Project, Volumes I-IV* from May 2002, which seems to be further updated until 2005. The report defines itself as representing a full description of the ESS project. It sets the construction costs at 1.552 million euros (11.560 million DKK, 14.540 million SEK), and in case that the construction costs are staged, at 1.662 million euros (12.380 million DKK, 15.570 SEK) at 2000-prices. The annual operating costs are set at 142 million euros (1.060 million DKK, 1.330 million SEK) at 2000-prices. A 15% contingency is included in the estimate. If an annual inflation rate of 2.5% until 2009/2010 – the earliest point of time, at which construction can begin - is included in the assessment as the report suggests, the constructions costs amount to 1.987-2.128 million euros, (14.810-15.860 million DKK, 18.210-19.500 million SEK). If inflation is included in the estimate of the operating costs in the same period, the corresponding figure for the operating costs is 182 million € (1.360 million DKK, 1.670 million SEK).

YOUR COMMENT: *(2) The contribution from international partners will almost certainly <u>not</u> be according to GNP but according to use, defined in advance.*

In my presentation, I referred to what Allan Larsson, former Swedish minister of finance and director general at the European Commission, stated in his June 2005 report *Svenskt värdskap för ESS*[4] (p. 34). Allan Larsson was asked by the Swedish government to review the possibility of hosting the ESS facility in Sweden. His report is generally presumed to be the basis for the Swedish government's decision to support ESS in Lund financially. If Allan Larsson's estimates are no longer valid, the public should be informed of what the new estimates are.

YOUR COMMENT: *(3) The 2.2 B€ you quote is unrecognisable. We presume it is simply speculation?*

The 2.2 billion euros estimate (slide 5) refers to a full implementation of the ESS project. It more or less corresponds to the most expensive scenario described in item (1) above. This estimate is the ESS organisation's own cost estimate. However, this is not the worst-case economic scenario. The worst case economic scenario is the Swedish Green Party assessment - construction costs doubled – in combination with the ESS organisation's own assessment of a staged ESS facility (slide 9). This

[2] Even the description of ESS in ESFRI's European roadmap from 2006, which is crucial for EU co-financing of the project, emphasises its inherent potential for expansion: "ESS will be the world's most powerful source of neutrons. Its built-in upgradeability (more than the initial 20 instruments, more power, more target stations) makes it the most cost-effective top tier source for 40 years or more", cf. European Strategy Forum on Research Infrastructures (ESFRI), *European roadmap for research infrastructures*, October 2006, p. 55, ftp://ftp.cordis.europa.eu/pub/esfri/docs/esfri-roadmap-report-26092006_en.pdf

[3] *The ESS Project, Volume III Update Report, Project Schedule, Organisation, Personnel and Costs,* 2005, s. 9-1-9-20, http://neutron.neutron-eu.net/FILES/Chapter_9_1_2005.pdf

[4] Allan Larsson, *Svenskt värdskap för ESS*, juni 2005, http://www.ess-scandinavia.org/new/source/dokumentation/ESSrapportenSlutligVersion22Juni2005.pdf

estimate amounts to 4-4.2 billion euros (36-39 billion SEK, 30-32 billion DKK), which is equivalent to more than 1 ½ the construction costs of the Øresund bridge. Obviously, with an ESS facility temporarily cut in half, this estimate is currently too high.

However, this does not apply to the cost overruns. According to a recent thesis by the Danish Professor of Planning at Aalborg University, Bent Flyvbjerg, cost overruns as well as benefit shortfalls are common in large infrastructure projects[5]. Planners and promoters deliberately misrepresent costs, benefits, and risks in order to increase the likelihood that it is their project and not the competition's projects that gain approval and funding. The ESS project possesses all the characteristics of a typical mega-project: Long planning horizons and complex interfaces, a multi-actor process with often conflicting interest regarding decision making, policy and planning, a project scope and ambition level that changes over time and unplanned events that are unaccounted for, leaving budget and other contingencies inadequate. As a consequence, misinformation about costs, benefits, and risks is regularly the norm, resulting in cost overruns and benefit shortfalls.

In his thesis, Bent Flyvbjerg mainly analyses transportation infrastructure projects, but the results are representative of other project types in other studies including power plants, dams, public buildings, sports facilities, water distribution, oil and gas extraction, information technology systems, aerospace systems, and weapons systems. Among the findings of the thesis is that 9 out of 10 projects found in the 20 nations and 5 continents covered by the study have cost overrun. This overrun is constant for the 70-year period covered by the study, i.e. estimates have not improved over time[6].

You do not have to look far to find a mega-project that in many ways is similar to the ESS facility: Although ESS in Lund is not a nuclear power station, it is still a nuclear installation. Currently, a nuclear installation is built in Finland - the European Pressurised Water Reactor Olkiluoto 3 (OL3). In August 2007, after 27 months of construction, the project was officially declared to be between 24 and 30 months behind schedule and at least 1.5 billion euros (14 billion SEK, 11 billion DKK) over budget. This overrun more or less equals 50 percent of the total budget. Since then, OL3 has been declared 2.5 years delayed after 2.5 years of construction. Construction will now take 6.5 years instead of the projected 4 years[7]. The delay of the project will cause additional work and costs. At this point in time, nobody knows how high the cost overruns will go.

YOUR COMMENT: *(4) The area of the designated site is ~2.0 km2. The footprint of the ESS facility will be 0.7 km2.*

That sounds very likely. Your ~2.0 km^2 estimate of the designated site is close to the estimate of the Working Group against ESS in Lund. For a long time, ESS Scandinavia set the facility's site requirements for the most advanced version of the ESS at 1-1.3 km^2. Now the consortium admits that this estimate is too low and not only that: The version of the ESS facility that ESS Scandinavia refers to, is a facility with only one neutron source. I.e. half the facility takes up the double space of the former site requirements estimate.

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[5] Bent Flyvbjerg, *Megaproject Policy and Planning: Problems, Causes, Cures, Sammenfattende redegørelse for doktorafhandling af Bent Flyvbjerg*, Institut for Samfundsudvikling og Planlægning Aalborg Universitet, 2007, http://www.plan.aau.dk/arrangementer/afhandlingBF2007s.pdf

[6] Ibid. p. 2- 4 and 12-14.

[7] C.f. http://www.platts.com/Nuclear/News/7764540.xml TVO source text: http://www.tvo.fi/1016.htm

YOUR COMMENT: *(5) The site will not be donated free of charge.*

Although I have no reason to disbelieve your assertion, it is a fact that the Council of the European Spallation Source Project establishes in its *Guideline on how to submit an expression of interest to host the European Spallation Source Project*, November 2001, that the site, the access roads, infrastructures, electrical power supplies, telephone and computer links, water mains, fire brigades, emergency preparedness, etc. are all supplied free of charge and that the ESS facility is exempted from tax payments by the hosting country. Furthermore, it is assumed that technical and administrative support will be given by the hosting country during the first period of the construction phase, while the autonomous ESS legal organisation is being implemented. Finally, the host country will cover any cost arising from site conditions deviating from the reference site specifications fence free of charge[8].

If the site is not donated free of charge, it raises the following questions: What is the price of an area of ~2.0 km^2 in the city of Lund? Who will pay for the site? Is it part of the cost estimate that you have given in your item (1) comment?

YOUR COMMENT: *(6) The number of instruments in the reference design is set at 22. Their capital cost is included in the 1377M€.*

The ESS project is historically a site-independent project consisting of two target stations and 44 instruments. The fact that it has been cut in half is probably the most remarkable development in the plus 10 year history of the project. At the same time, it is also a very questionable decision. A lot of questions seem relevant. One of them is: How many of the advertised benefits of the facility are expected to disappear? The marketing of the ESS project has not changed since the decision to reduce the project. Furthermore, according to Allan Larsson and ESS Scandinavia itself, this reduction might only be temporary, reflecting the current lack of funding prospects. As mentioned above, for tactical and strategic reasons, promotion of the full project is not economically feasible at this point in time. However, the construction costs of the reduced project are rapidly growing: They are almost 15% higher than the February 2007 estimate of the Swedish government when it decided to support the project financially and the estimate of Allan Larsson's 2005 report *Svenskt värdskap för ESS* (1.200 million euros, 8.800 million DKK, million 11.000 SEK) and at least 30% higher than the estimate of ESFRI's 2006 *European roadmap for research infrastructures* (1.000-1.050 million euros, 7.400-7.800 million DKK, 9.300-9.800 million SEK).

Am I correct in assuming that the costs of the ESS facility have increased significantly? The ESS facility is not a site-specific project. So it must be assumed that the design and the scope of the ESS project have been reduced with respect to the other candidate sites as well?

[8] *The ESS Project, Volume III Update Report, Project Schedule, Organisation, Personnel and Costs,* p. 9-12, and Council of the European Spallation Source Project, *Guideline on how to submit an expression of interest to host the European Spallation Source Project*, November 2001, p. 4, http://neutron.neutron-eu.net/FILES/site_selection_procedure.pdf

YOUR COMMENT: *(7) Your "worst-case scenario" is not based upon facts.*

So far, nobody knows for sure what a worst case scenario would be like, not even ESS Scandinavia who is promoting the project. Currently, it is not known how high the content of radioactive heavy metal in the facility will be or even what kind of heavy metal, which will be used. A report from Lunds tekniska högskola from April 2006 sets the content at 30-40 tonnes[9]. One report from Studsvik Nuclear AB from March 2005 sets the content 30 tonnes[10], another Studsvik report at 40 tonnes[11]. Considering that ESS is a nuclear facility – although not a nuclear power station, which means that the potential release of radioactive substances does not comprise the same elements – it should be noted that the content of radioactive heavy metal in these estimates is equivalent to approximately half of the content of radioactive heavy metal in the Barsebaeck 2 reactor[12]. Lunds Naturskyddsförening sets the content of heavy metal between 20 and 60 tonnes. If the content of mercury is higher than 50 tonnes, ESS legally has to be classified in the same category as the Seveso facility[13].

It is beyond doubt that an ESS facility located in Lund could have significant environmental and economic consequences not only for Skåne but also for Copenhagen and the Danish metropolitan area in case of a serious accident. These concerns are augmented by unanswered questions related to risk assessments of all parts of the outlined ESS facility and elaboration of worst-case scenarios, including the impacts of these scenarios on a regional scale. Larger cities near the proposed location of the ESS facility are: Lund (ESS facility 5 km from city centre, 100.000 inhabitants), Malmö (ESS facility 25 km from city centre, 262.000 inhabitants), Copenhagen and the Danish metropolitan region (ESS facility 40 km from city centre, 1.810.000 inhabitants) and Helsingborg (ESS facility 50 km from city centre, 119.000 inhabitants).

It should be remembered that among the critics of the facility's high content of mercury – as outlined in the original reference design - are the Swedish Environmental Protection Agency, the Swedish Chemicals Agency and several green NGOs, including the Swedish Society for Nature Conservation. The background of the criticism is among others that the Swedish Parliament decided in 1991 that 75% of the mercury consumption in Sweden must be phased out by 2010 and that the Swedish government in its environmental objectives proposal from 2004 established that 95% of the mercury consumption has already been given up. Furthermore, the Swedish government contemplates issuing a ban against the use of mercury.

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[9] Mattias Jönsson & Johan Rönmark, *European Spallation Source ur ett riskperspektiv*, Report 5202, Brandteknik, Lunds tekniska högskola, Lunds universitet, Lund 2006, p. 45, http://www.brand.lth.se/bibl/pbr-5202.pdf. The report is financed by Lund Municipality.

[10] Evert Eriksson, *Overview of Safety Aspects for European Spallation Source (ESS), for a location in Skåne*, STUDSVIK/N-05/070, p. 17, 2005, http://www.ess-scandinavia.org/new/source/dokumentation/N-05-070_ESS%20PSAR.pdf

[11] Ulla Bergström, Erik Hellsten, *Overview of aspects for safe disposal of mercury from a European Spallation Source, located in Sweden*, STUDSVIK/N-05/073, http://www.ess-scandinavia.org/new/source/dokumentation/N-05-073_ESS%20mercury.pdf

[12] The reactor core of Barsebaeck 2 contained 444 fuel assemblies. The fuel weight per assembly was 172 kgU/assembly totalling a weight of 76.4 tons of heavy (uranium) metal (tHM), cf. *Barsebäcksoffensivs (BBOFF) høringssvar af 11/6 2004 i forbindelse med Barsebäckværkets ansøgning om miljøgodkendelse*, p. 33, http://www.noah.dk/energi/BBOFF.pdf

[13] *European Spallation Source ur ett riskperspektiv*, p. 45.

YOUR COMMENT: *(8) ESS in Scandinavia is "marketed" as a scientific research facility. Other aspects are of course important but secondary to the principal goal.*

I disagree with your description of the marketing of ESS in Lund. Historically, it can be divided into four phases:

The first phase, in which emphasis was mainly put on ESS as a *scientific project*. This phase lasted until July 2002, where The German Science Council (GSC), published its assessment: *Statement on nine large-scale facilities for basic scientific research and on the development of investment planning for large-scale facilities*[14]. Here, the GSC rejected the scientific legitimacy of ESS project and recommended continued work on the facility's scientific programmes and technical design, after which a new project proposal should be presented. This assessment caused the German government to withdraw its support for the two German site candidates, Forschungszentrum Jülich in Nordrhein-Westphalia and Halle-Leipzig backed up by the Federal States of Saxony and Saxony-Anhalt. Furthermore, the British government decided to upgrade an already existing neutron-scattering facility - the ISIS neutron source at the Rutherford Appleton Laboratory - which effectively eliminated the two English candidates, Oxfordshire and Yorkshire, from the race. This was a low-point for ESS on the European level and brought promotion of the ESS project to a standstill for a considerable amount of time.

The second phase, in which emphasis was mainly put on ESS as a *large-scale regional development project*. This phase lasted from July 2002 until March 2004. After the elimination of the then competing site candidates from the race, ESS Scandinavia was expected to launch a successful campaign to get the project to Sweden. However, attempts to get economic support from the Swedish government failed and efforts to build a Pan-Scandinavian hosting platform were unsuccessful, especially after the rejection by the Danish Minister of Science, Technology and Research in October 2003. Sensing that Sweden would have to finance the ESS project mainly by itself, ESS Scandinavia started to put emphasis mainly on the alleged regional economic benefits of the project. The consortium had already commissioned a report from the Swedish energy consultant agency *ÅF Energi & Miljö AB*, which estimated the ESS facility's effect need to be 120-150 MW[15], corresponding with a Danish city of between 89.000 and 111.000 inhabitants. ESS Scandinavia now turned the high electricity consumption into a selling point and in January 2004, *ÅF-Energi & Miljö AB* issued another report commissioned by ESS Scandinavia – this time estimating the future costs for electric energy for the ESS facility and the income for the Swedish electricity market and revenue from taxes to the Swedish government[16]. In a scenario with the facility's power demand set at 120 MW, the report estimated the total costs for the electricity supply to be 49-59 M€/year in 2010 and 55-81 M€/year in 2020. The revenue to the government from energy tax was estimated to be 25-32 M€/year in 2010 and 31-46 M€/year in 2020. Finally, the income to electricity suppliers from ESS in Lund was estimated to be approx. 22 M€/year in 2010 and 23-30 M€/year in 2020.

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[14] The German Science Council, *Statement on nine large-scale facilities for basic scientific research and on the development of investment planning for large-scale facilities*, Berlin, 12 July 2002, http://www.wissenschaftsrat.de/texte/5385-02.pdf

[15] Karin Byman, David Ringmar och Maria Stenkvist,– *Elförsörjning till European Spallation Source – en forskningsanläggning i Sydsverige*, ÅF Energi & Miljö AB, Stockholm 2003-03-03, p. 6, http://www.ess-scandinavia.org/new/source/Nyheter/AF_ESS_030303.pdf

[16] ÅF-Energi & Miljö AB, Rapport nr SR-ESS 040107, *Ekonomisk analys gällande elförsörjningen av European Spallation Source byggd i Lund, Öresundsregionen*, Stockholm, 2004-01-07, http://www.ess-scandinavia.org/new/source/Nyheter/SR%20ESS%20040107.pdf

At the same time two recommendations were introduced in the Committee for Trade and Industry in the Swedish parliament, calling on the Swedish government to promote ESS in Lund. However, both recommendations were rejected[17].

The third phase, in which ESS was mainly marketed as a *down-scaled regional development project*. This phase lasted from March 2004 until February 2007. In July 2004, the Swedish Government asked Allan Larsson, former minister of finance and director general at the EU-Commission, to review the possibility of hosting the ESS facility in Sweden[18]. The outcomes of Allan Larsson's inquiries were published in a report in June 2005 - *Svenskt värdskap för ESS*[19]. His main conclusion was a recommendation to the Swedish government to give a declaration of intent, stating that Sweden would prepare a bid to host the ESS. According to Allan Larsson's report, Sweden would make two types of contribution to the financing of the ESS project. A basic financing originating from Sweden's GNP-share among the participating OECD-countries that Sweden had to pay irrespective of where the ESS facility was built and additional hosting costs, i.e. 20-25% of the construction costs. EU co-financing could cover up to 10% of the investment costs and 50% of the project planning costs[20].

The proposed solution to the problems that had haunted ESS in Lund in the past was both inventive and simple: On one hand, all the benefits of a fully implemented ESS facility was maintained and on the other hand, the facility was to be cut in half, reducing the number of instruments available from 44 to 22. This way, the reservations concerning the high cost levels of a fully implemented ESS could be overcome. However, the down-scaling of the ESS project would only be temporary. ESS Scandinavia would still opt for full implementation of the project, when the time was right.

The two chief arguments for ESS as a regional development project is best summarised in an application from ESS Scandinavia to Region Skåne in November 2006[21]: (1) For every investment unit that Sweden invests in the construction of ESS, other countries participating in the project will invest two units. And for every investment unit, Sweden puts in the operation of the ESS facility other countries will invest nine units. (2) The ESS facility is expected to be visited by 5.000 neutron researchers annually, a number so high that it will inevitably boost the local economy. It can be argued that these were the arguments that persuaded Lund Municipality, Region Skåne, other local donors[22] and ultimately the Swedish government to support the concept of locating ESS in Lund financially.

However, both these arguments are doubtful at best. With respect to (1), the Swedish Agency for Public Management has determined that there are significant uncertainties with respect to the size of the contributions that even binding agreements cannot resolve and the risk that the participating countries abandon these agreements is very real. This means that the question of origin and division of financing for ESS is far from resolved. Concerning (2), the figure of 5.000 annually visiting

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[17] Näringsutskottet 2003/04:NU10, Utskottets överväganden, Neutronforskningsanläggningen ESS, p. 78-79, http://www.ess-scandinavia.org/new/source/Nyheter/Senaste%20ESS.pdf

[18] Utbildningsdepartementet, Pressmeddelande 8 juli 2004, *Uppdrag till Allan Larsson att undersöka möjligheten att placera European Spallation Source i Sverige*, http://www.regeringen.se/sb/d/4164/a/27275/m/wai;jsessionid=aR4nIFbLDexg

[19] Allan Larsson, *Svenskt värdskap för ESS*, juni 2005, http://www.ess-scandinavia.org/new/source/dokumentation/ESSrapportenSlutligVersion22Juni2005.pdf

[20] Ibid. p. 60.

[21] http://www.skane.se/pages/184248/RTN20070115.2.3.pdf and http://www.skane.se/templates/Page.aspx?id=178956

[22] E.g., see http://www.lu.se/o.o.i.s?id=1187&news_item=1882

researchers represents an exaggeration of the user basis of the ESS project by a factor 3 according to ESS Scandinavia itself, cf. comment (9) below.

The fourth phase, in which ESS is being *green-washed*. This phase started in February 2007 and will probably go on indefinitely, considering that the ESS project is not an environmentally sustainable project.

YOUR COMMENT: *(9) The European community of researchers who use neutrons is currently ~4500. Over a 3-year period they will all use ESS.*

This is interesting new information, considering that ESS Scandinavia routinely has mentioned a figure of 5.000 annually visiting researchers, when it defines the user basis of ESS[23] - a figure that roughly corresponds to estimates of the entire European neutron scattering community. The figure also underpins the Swedish government's decision to financially support ESS in Lund[24]. Hence, this new estimate seems to have two implications: On one hand, that the European neutron scattering community is only in the order of 4.500 researchers – considerably lower than earlier estimates – and on the other hand that the ESS facility will only be visited by 1.500 researchers annually. This means that previous estimates of ESS Scandinavia regarding the number of annually visiting researchers have been exaggerated by a factor of 3.

The number of visiting researchers is a key figure, considering that the ESS project is mainly marketed as a regional development project. Hence, one could argue that it is the principle deciding factor in the Swedish government decision to support the project financially and also in Lund Municipality's, Region Skåne's and other local donors' decision to support the ESS project with funds.

The new estimate also raises a lot of questions: Why the new estimate? What are the implications for the scientific legitimacy of the ESS project? Is the European neutron scattering community growing or in decline? How big is e.g. the Swedish neutron scattering community? It has already been established how many Danish researchers can apply ESS in their research, cf. item (15) below. How many of the Swedish researchers can use the ESS facility in their research? ESS Scandinavia is currently trying to develop a Scandinavian platform to host ESS in Lund. How big is the Scandinavian neutron scattering community? How many of the Scandinavian researchers can use the ESS facility in their research?

YOUR COMMENT: *(10) The paper in Science from CCLRC on a fusion source of neutrons is very futuristic. It has been discredited as a practical source of neutron beams in the foreseeable future (i.e. at least 50 years ahead) by a large group of scientists.*

[23] E.g. cf. an application from ESS Scandinavia to Region Skåne 13 November 2006 for 450.000 SEK, which was granted 15 January 2007, http://www.skane.se/pages/184248/RTN20070115.2.3.pdf and http://www.skane.se/templates/Page.aspx?id=178956

[24] The Swedish government mentions 4.000-5.000 visiting researchers per annum, cf. The Swedish Ministry of Education and Research, *Locating the European Spallation Source (ESS) in Sweden*, Memorandum, 26 February 2007, p. 2, http://www.sweden.gov.se/content/1/c6/07/74/78/062c65e4.doc

That might be true, but where is the evidence of this assertion? To my knowledge, so far only one response has been published to the paper in Science. As mentioned in my presentation (slide 16), leading neutron scientists at CCLRC Rutherford Appleton Laboratory and Edinburgh University have described how fusion research can be applied to develop the world's most powerful neutron source for materials science research[25]. This new neutron source, which can be envisaged on a 20- to 30-year time scale, is expected to be a least 1000 times more powerful than the best neutron sources currently available worldwide. Kurt N. Clausen and Joël Mesot have recently published an editorial in Neutron News, rejecting the practicality of this concept[26]. They might be right, but they can hardly be perceived as impartial, considering that Kurt N. Clausen is a former ESS project director and Joël Mesot is from the Paul Scherrer Institute, which has been active in the feasibility study of the ESS project.

Whether there has been a scientific debate on this subject seems unclear. It is also difficult to find out how this new discovery is perceived in the European neutron scattering community. It does not seem to be mentioned at the European Neutron Portal, which otherwise has a very extensive news presentation[27]. During the 5-day ENSA conference in Lund 25-29 June 2007[28], which was attended by the Swedish Minister for Higher Education and Research, Lars Leijonborg, the discovery was apparently not an issue. Among the more than 130 speakers at the conference, none of nine authors of the article in Science seem to have been represented[29]. This is striking, considering that the leap forward in neutron source capacity is expected to revolutionise neutron science completely. It should also be noted that the main author of the article in Nature, Andrew Taylor, is the director of ISIS, which is considered the world's leading pulsed neutron and muon source, supporting an international community of around 1.600 scientists[30]. In 2005 he was awarded the Glazebrook medal and prize for his work in the field of neutron science and for the realisation of the proposed second target station for ISIS[31].

YOUR COMMENT: *(11) Transmutation of nuclear waste is an idea of The Nobel Prizewinner Carlo Rubbia. Very little work has been done practically of it and it is not a proven technique. The ESS is not designed for, nor will it be used for the transmutation of nuclear waste. We wish to emphasis this categorically.*

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[25] Andrew Taylor, Mike Dunne, Steve Bennington, Stuart Ansell, Ian Gardner, Peter Norreys, Tim Broome, David Findlay, Richard Nelmes, *A Route to the Brightest Possible Neutron Source?*, Science 23 February 2007: Vol. 315. no. 5815, pp. 1092 – 1095, http://www.sciencemag.org/cgi/content/abstract/315/5815/1092, http://www.isis.rl.ac.uk/aboutIsis/index.htm?content_area=/aboutIsis/news2007_02_1.htm&side_nav=/aboutIsis/aboutisisSideNav.htm& and http://www.scitech.ac.uk/PMC/PRel/Arch/CCLRC/2007/20070223.aspx See also: Ingeniøren, *Laser fusion er nøglen til fremtidens neutronkilder*, 4/3 2007, http://ing.dk/artikel/77212, The Economist, *Firing new shots*, *Using lasers to trigger fusion could prove cheaper than other techniques*, April 19th 2007, http://www.economist.com/science/displaystory.cfm?story_id=9033026

[26] Kurt N. Clausen and Joël Mesot, *Editorial: The Route Forward for Europe: The European Spallation Source (ESS)!*, Neutron News, Volume 18, Issue 4, October 2007 , pages 2 – 3, http://www.informaworld.com/smpp/content?content=10.1080/10448630701623038

[27] E.g. see http://neutron.neutron-eu.net/n_news

[28] Conference website: http://www.ecns2007.org/index.asp The conference was organised by the European Neutron Scattering Association (ENSA), the Swedish, Norwegian and Danish Neutron Scattering Societies and Lund University.

[29] http://www.ecns2007.org/pdfs/index_sessions_speakers.pdf

[30] http://www.isis.rl.ac.uk/aboutIsis/index.htm

[31] http://www.scitech.ac.uk/PMC/PRel/Arch/CCLRC/2005/20051006.aspx

I agree that transmutation of nuclear waste is not a proven technique. However, it is a fact that nuclear waste transmutation experimentation was a strategic and logical orientation of the ESS project until 2001. Future adaptation of a redefined project in order to carry out transmutation experiments is both feasible without major technically challenge and economically achievable. Whether it will happen is of course another question, but it is a fact that transmutation research takes place in Sweden. The Swedish National Council for Nuclear Waste (KASAM) has published a report, *Kunskapsläget på kärnavfallsområdet 2004 (SOU 2004:67)*[32], according to which research of separation and transmutation of nuclear waste is taking place at Chalmers University of Technology[33], KTH - Royal Institute of Technology, Uppsala University and Studsvik AB (cf. p. 361-364). The research project *Impact of Partitioning, Transmutation and Waste Reduction Technologies on the Final Nuclear Waste Disposal*[34], which comprised partners from 20 leading European organisations and research institutions, was administered by the KTH School of Science, Department of Nuclear and Reactor Physics. KTH is currently involved in the EUROTRANS[35] project and was involved in the ADOPT[36], CONFIRM[37], PDS-XADS[38] and TECLA[39] projects, which are transmutation related. There are currently in the order of 30 Swedish researchers and engineers involved in transmutation research activities in Sweden and abroad[40]. Chalmers University of Technology, KTH - Royal Institute of Technology and Studsvik Neutron Research Laboratory are all members of the ESS Scandinavia Consortium.

YOUR COMMENT: *(12) We are baffled by your statement beginning "7 of the 26 neutrons….etc". What facts do you base this statement on?*

The statement in slide 18 that 7 of the 26 neutron scattering facilities around the world have designs comparable with the ESS and most of them are been equipped with sub-critical reactors allowing transmutation studies is a quotation from Vincent Legrand, Xavier Coeytaux, Mycle Schneider, Yacine B. Faïd, *The European Spallation Source Project and Nuclear Waste Transmutation*[41], WISE-Paris, Paris, 28 November 2002, p. 11. These facilities are:

1. KENS Neutron Scattering Facility, KEK, Tsukuba, Japan (500 MeV)
2. Kyoto University Research Reactor Institute (KURRI), Kyoto, Japan (46 MeV)
3. Interfacultair Reactor Instituut, Delft University of Technology, Netherlands(3 MeV)
4. ISIS Pulsed Neutron Facility, Rutherford-Appleton Laboratory, Oxfordshire, UK (800 MeV)
5. Swiss Spallation Neutron Source (SINQ), Paul Sherrer Institut, Villigen, Switzerland (590 MeV)

[32] http://www.sou.gov.se/kasam/Ny_mapp%20PDF/SOU2004_67_3.pdf
[33] See also: http://www.chalmers.se/en/sections/research/research_profiles/chemical_and_biologi/nuclear_chemistry
[34] http://cordis.europa.eu/fetch?CALLER=PROJ_EURATOM_FP6&ACTION=D&DOC=14&CAT=PROJ&QUERY=1200487600227&RCN=74119
[35] http://researchprojects.kth.se/index.php/kb_1/io_9557/io.html
[36] http://www.ist-world.org/ProjectDetails.aspx?ProjectId=86bd4aa2ec5f4218adaebfba2a21d796
[37] http://researchprojects.kth.se/index.php/kb_1/io_8674/io.html
[38] http://www.ist-world.org/ProjectDetails.aspx?ProjectId=8967aae2277f4e079cb152721f8b29ad
[39] http://www.ist-world.org/ProjectDetails.aspx?ProjectId=25053695561149a6be2076d29040b956
[40] http://www.neutron.kth.se/transmutation/Transmutation.pdf
[41] http://www.folkkampanjen.se/doc1/wise021127essmemo.pdf

6. Intense Pulsed Neutron Source (IPNS), Argonne National Laboratory, Illinois, USA (450 MeV)
7. Los Alamos Neutron Scattering Center (LANSCE), New Mexico, USA (800 MeV)

YOUR COMMENT: *(13) Every human activity carries with its risks. ESS is no different. These risks will be managed to the highest professional standards and will be monitored by national and international authorized. The scenarios, which you envisage have extremely low probabilities compared to the risks you, expose yourself to daily.*

I profoundly disagree with this assertion. There is a fundamental moral difference between taking risks on ones own behalf and taking risks that potentially involve hundreds of thousands and perhaps even millions of other people. Apparently, ESS Scandinavia is willing to do both. Furthermore, if the economic benefits are compared to the potential risks, it is doubtful whether there are benefits for other than the relatively few people who will work at the facility. E.g. the Swedish Agency for Public Management has predicted that the ESS project could fail as a regional development project. In a position paper from 2005, the Agency states that it is difficult to assess the dynamic effects of a location of ESS in the Øresund region and because it is impossible on the basis of analyses of similar facilities to convert the research infrastructure investment to jobs and income for society, assessments of the facility must be based on other criteria[42].

Risk management living to the highest professional standards would imply publication of worst-case scenarios for a serious accident at the ESS facility. Such scenarios have not been produced and the idea is not promoted by ESS Scandinavia.

Technically, the ESS facility is a nuclear installation because of its high content of radioactive material. Because of the research facility's potentially high danger level, its operator will probably be liable for any damage caused by the facility, regardless of fault. In such a case, the operator - in this case ESS Scandinavia – would be expected to take out insurance, and is in most countries required to do so. Furthermore, with respect to nuclear installations, national laws are supplemented by a number of international conventions. Liability is limited by both international conventions and by national legislation, so that beyond the limit normally covered by insurance the state can accept responsibility as insurer of last resort.

In case of a serious accident at the ESS facility, nuclear damages might affect both Sweden and Denmark. As regards the civil liabilities connected with a serious accident in a nuclear installation that concerns an international third party there are two levels of liability: For the operator and for the state. According to the *Annex to Sweden's second national report under the Convention on Nuclear Safety, Ds 2001:41*[43], the national legislation in Sweden, which implements the obligations under the Paris Convention and the Brussels Supplementary Convention[44] on the practical

[42] Statskontoret, Enheten för styrningsfrågor, *Remissvar, Svenskt värdskap för ESS (Ds 2005:20)*, p. 1, http://www.statskontoret.se/upload/Remissvar/2005/2005324.pdf#search=%22Statskontoret%20remissvar%20ESS%22

[43] http://www.ski.se/extra/tools/parser/index.cgi?url=/html/parse/index.html&selected=5&mainurl=/extra/document/%3Fmodule_instance=1%26action_show_category.1.%3D1

[44] The most important international treaty on liability and nuclear power that has been ratified by Sweden and Denmark is the *Convention on Third Party Liability in the Field of Nuclear Energy* a.k.a. *The Paris Convention* that was adopted in Paris July 29th 1960, amended January 28th 1964 and entered into force April 1st 1968.

provisions for insurance of nuclear installations, is the Act on Nuclear Liability[45]. This Act provides that the operator of a nuclear installation, which is the source of a nuclear incident, is liable to provide compensation to those who have suffered personal injury or damage to property as a result. The liability of the operator is strict and exclusive. Like the Paris Convention the Swedish Nuclear Liability Act provides that the operator of a nuclear installation is liable to pay damage even if there has been no fault or negligence on his part. However, the operator is not liable for nuclear damage caused by a nuclear incident directly due to an act of war, armed conflict, civil war or insurrection or caused by a grave natural disaster of an exceptional character[46].

Without potential impact scenarios for a serious accident in the ESS facility, especially with respect to worst case scenarios, it will probably be very difficult to take out a policy. Also, what level of responsibility would the Swedish government be willing to commit to? In case of Danish co-hosting of ESS in Lund, how large a responsibility would the Danish state be willing to accept? What is the liability of the members of the ESS Scandinavia Consortium (Lund Municipality, Lund University, Copenhagen University, etc.)? Any responsible approach to the liability problem would require clarification of the legal and moral aspects of these issues.

Matters are further complicated by the fact that the ESS facility in spite of its high content of nuclear material might not legally be categorised as a nuclear installation. Indications are that the ESS facility will not be regulated by the Swedish Act on Nuclear Liability, the Vienna Convention on Civil Liability for Nuclear Damage, the Paris Convention on Third Party Liability in the Field of Nuclear Energy, the Brussels Supplementary Convention or any other international framework related to liability regimes for nuclear installations. This would give the victims in Sweden and Denmark even less economic protection in case of a serious accident at the ESS facility.

YOUR COMMENT: *(14) Electricity needs are 40 MW and not 120 to 150MW. We aim, intelligent building design to get this need down below 35 MW. We will have a carton-neutral policy based upon electricity generation by renewals. We are a partner*

The efforts to reduce the electricity consumption of the ESS facility are commendable. However, it should be noted that the main reason for the reduction of the electricity needs from 120-150 MW to 40 MW is not application of energy efficiency, but the fact that the ESS facility in its current version only comprises one neutron source. As mentioned in *the ESS Scandinavian proposal* and ESFRI´s *European roadmap for research infrastructures*, this could quickly change if sufficient financing can be found. The ESS facility would then be back to an electricity need of 120-150 MW.

In should also be noted that an electricity need of 40 MW is still a considerable amount of electricity. It corresponds to the power capacity of the Middelgrunden offshore wind farm east of the Copenhagen harbour, which until 2001 was the world's largest offshore wind farm[47]. It also corresponds to more than 35% of the power capacity of Vattenfall's Lillgrund offshore wind farm, south of the Øresund Bridge. The Lillgrund offshore wind farm, which is the largest in Sweden has

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The Paris Convention was amended by the *Convention Supplementary to the Paris Convention on Third Party Liability in the Field of Nuclear Energy* (as amended) that was adopted in Brussels January 31st 1963, January 28th 1964 and November 16th 1982, http://www.nuclearfiles.org/redocuments/1963/630131-liability-suppl.html

[45] See http://www.nea.fr/html/law/nlb/NLB-01-EN.pdf and http://www.nea.fr/html/law/nlb/nlb-67/029_058.pdf

[46] Swedish Nuclear Liability Act, Section 11, Subsection a and b, http://www.nea.fr/html/law/nlb/NLB-02-SUP.pdf

[47] http://www.middelgrunden.dk/MG_UK/news/updated_news.htm

a capacity of 110 MW and is expected to provide electricity to approximately 60.000 Swedish households[48].

Finally, it should be emphasised that a carton-neutral policy for ESS in Lund does not only pertain to the electricity consumption of the facility. In order to implement such a policy, life cycle assessments should be carried out with respect to all activities related to the ESS project. Particularly, life cycle energy analyses, in which all energy inputs to the ESS project are accounted for, would be relevant. Theses would include all energy inputs needed to build the facility and the infrastructures surrounding it, its operation and particularly the extensive travel activities of 1.500 annually visiting researchers, the decommissioning and the dismantling of the facility and the storage of the radioactive heavy metal from the target station(s), which will have to be stored in a nuclear waste repository for 3.000 years after the decommissioning of the research centre.

YOUR COMMENT: *(15) We are currently seeking partners for this project. As you would expect the Nordic countries are parts of our discussions.*

Scandinavian government partners will have to lift a heavy economic burden if they decide to co-host ESS in Lund. Based on the Swedish government's proposal from 2007, Denmark's investment in case of Danish co-hosting will be in the order of 440 million euros (3.300 million DKK, 4.100 million SEK)[49]. This is equivalent to more than 115% of the total 2003 appropriations in the fields of social sciences and the humanities, including psychology and theory of education,[50] or all of the 2005 research budgets of the University of Copenhagen, the University of Aarhus and Aarhus Business School put together[51].

In 2003, the Danish Minister of Science, Technology and Research, Helge Sander, established in an answer to a question posed in the Committee for Science and Technology in the Danish Parliament, that only 20 Danish neutron researchers can apply ESS in their research. In case of Danish/Swedish parity concerning the economic burden of co-hosting ESS in Lund, a Danish user basis of 20 neutron researchers will – in light of the Swedish government's 2007 proposal - require a Danish investment of 22 million euros (165 million DKK, 205 million SEK) for each researcher. 165 million DKK is equivalent to 57% of the total public and user financed funds, which was appropriated for RD&D in the field of energy in Denmark in 2005, including renewables[52], or 165%

[48] http://www.vattenfall.com/www/vf_com/vf_com/365787ourxc/366203opera/555848newpo/557Lillgrund offshore wind farm0Lillgrund offshore wind farm04biofu77761/366331lillg/index.jsp

[49] The assessment is based on the Swedish government's Swedish press release and covers the total costs (15% of the construction costs plus 5% of the operating costs during a 40-year period). The basic financing originating from Denmark's BNP-share among the participating OECD-countries is not included in the estimate.

[50] In 2003, the Danish appropriations for R&D amounted to 1.359 million DKK for social sciences (equivalent to 12% of the total research appropriations) and 1.467 million DKK for the humanities, including psychology and theory of education (equivalent to 13% of the total research appropriations), cf. Sekretariatet for ministerudvalget for Danmark i den globale økonomi, *Bilag om bevillinger til offentlig forskning*, Bilag 1, 30. november 2005, p. 3, http://www.globalisering.dk/multimedia/Faktabilag_1_offenlig_forskning.pdf

[51] In 2005, the research budgets for the institutions in question came to: *The University of Copenhagen*: 1.855,3 million DKK, *the University of Aarhus*: 1.332,2 million DKK, and *Aarhus Business School*: 116.3 million DKK, cf. Sekretariatet for ministerudvalget for Danmark i den globale økonomi, *Bilag om bevillinger til offentlig forskning*, Bilag 2, 30. november 2005, p. 3, http://www.globalisering.dk/multimedia/Faktabilag_2_offentlige_forskningsbevillinger.pdf

[52] The sum amounted to 292 million DKK, cf. Energistyrelsen, *Notat*, 17. marts 2005, offentliggjort af Det Energipolitiske Udvalg (EPU), alm. del - Bilag 63, p. 1, http://www.folketinget.dk/samling/20042/almdel/EPU/Bilag/63/158383.PDF

of the funds that were transferred to the R&D budget items "culture, mass media and leisure" in the public research budgets the same year[53] or more than there was appropriated for research in 2005 at the Danish IT University and Århus Business School put together[54].

This has to be compared to questionable economic benefits for the Øresund region of this investment, the obvious environmental hazards of the ESS project and the high risk that further investments will be required during all phases of the planning, construction, operation and decommissioning of the ESS facility.

In conclusion, I would like to say this: The difficulty of analysing ESS is not only to try to grasp what the project appears to be, but also what it is, is planned to be and ultimately could turn out to be. It is not the same thing. All the issues discussed in this letter have changed significantly over time: Estimates of cost levels, cost divisions, site requirements, number of target stations, number of instruments, number of visiting researchers, approach to transmutation research, marketing strategies, risk and impact scenarios to the extent that they exist at all, electricity consumption, benefits, sustainability, etc. Almost all of them could be expected to change again. The only constant factor seems to be the willingness of ESS Scandinavia to tell the public and the political decision-makers what appears to be the most convenient at any given point in time.

More than ever it is imperative that a comprehensive, independent analysis on the content, developments and impact of the ESS project is made before any political decision on the further viability of the project is taken. As matters are now, regional, national and European decision-makers have no way of knowing what they are saying yes or no to. The analysis should comprise an independent in-depth assessment of the justification, long-term orientation, environmental and social benefit and effects of the project. The project's local and regional safety implications should be analyzed as well as the project's role in the EU policy for sustainable development, especially as regards the considerable energy consumption of the research facility. In order to guarantee the neutrality of the investigation one or more independent research agencies should participate in this enterprise.

Yours sincerely,

Niels Henrik Hooge

[53] The sum amounted to 108.4 million DKK, cf. Statens forskningsbudgetsystem, december 2005.
[54] In 2005, this sum amounted to 43.9 million DKK for the Danish IT University and 116.3 million DKK for Århus Business School, cf. *Bilag om bevillinger til offentlig forskning*, s. 3.