

Ardeer public meeting (held via Teams) Wednesday 26th January 2022

The following questions were asked during the public session in the meeting chat function; time constraints meant they could not all be dealt with during the meeting. We are pleased now to provide fuller responses below.

These responses have been prepared by the Fusion Forward bid consortium (University of Glasgow, North Ayrshire Council and NPL) and reviewed by the UKAEA STEP team.

Prof. Declan Diver, Professor of Plasma Physics, the University of Glasgow, has provided his expertise to answer the technical questions that centre on fusion technology itself. Other points have been addressed by relevant partners and Council officers.

Why is Ardeer the only proposed site in Scotland? I think that it's frustrating that many of us in Stevenston and the community have been crying out for the peninsula to be used as a nature reserve and the land to be left alone, for sand mining to stop with no joy! Which I do understand is largely due to the outdated SDO. It however does not lessen the blow that the land is now being considered for a large-scale industrial experiment. Yes, in the past it was an industrial site but that does not mean it has to be again, as well as considering that in the timeframe of planning to construction couldn't the time be better spent investing in and improving renewables?

There were 5 possible sites in Scotland, but only one of these – Ardeer – made the shortlist. Ardeer is a wonderful site: it is enormous – more than 670 hectares, of which the competition needs around 100-150 ha; has excellent transport links (road and rail); is coastal, enabling both sea cooling and sea transport for larger construction items; is well placed for electrical supply; has excellent educational and training infrastructure (all 4 universities in Glasgow, and all FE colleges in Glasgow and Ayrshire will cooperate on delivering comprehensive training for all stages of the workforce); has progressive local and regional government, each with a climate emergency declared and a commitment to decarbonising industry; the prevailing socio-economic conditions in the local area merit such an investment.

Has both an industrial allocation and is identified in the adopted Local Development Plan and as an area for potential future growth.

Why is Ardeer a good location for this plant?

See the earlier response: Ardeer has the space, flexibility, coastal site, excellent transport links, excellent education and proximity to a large population base: all these are desirable aspects for such a development.

Are there other programmes like STEP getting started now?

There are fusion projects around the world, including many in the UK, but only the STEP project has an explicit aim to produce electricity for the national grid from fusion.

As far as I am aware you need high pressure and high temperatures to initiate the fusion reaction. You can absolutely guarantee there cannot be an uncontrolled reaction?

What safeguards are there in the design and system to ensure there can never be an uncontrolled nuclear fusion reaction?

For magnetic confinement fusion, you do need high temperature, but the density of the fuel gas is very low (one ten millionth of atmospheric density), so overall these are not high-pressure devices at all.

Magnetic confinement fusion can't lead to an uncontrolled (or chain) reaction: fusion doesn't occur naturally at all on a planet, but only in the cores of stars, where the compression is so huge that fusion automatically occurs.

Whilst fusion reactions don't occur naturally on Earth, they can be persuaded to occur under the special conditions of a tokamak; if the tokamak is unable to reach these conditions, the reaction stops. A tokamak only holds enough fuel for 10s or so of operation, so again if it needs to be shut down, then this is essentially instant.

We can't produce that compression on the earth with a tokamak, but we can use a tokamak to cause fusion to occur under specialised conditions where the targets are hot but very, very dilute – the density of material inside the fusion chamber is only 1 ten millionth of the density of air at sea level. If the temperature drops, or if the density increases, the reaction can't proceed. The magnetic fields keep the hot fuel (at 10 million degrees C) away from the vessel walls where it might damage them. In fact, there is only a few grams of fuel in the reactor at any instant – only enough for 10s or so of operation.

Contrast this with conventional nuclear fission, where there can be weeks or months of fuel inside the vessel; given that the fission reaction is naturally occurring, and can proceed automatically unless prevented, you can see that fusion reactors are fail-safe.

“a well-known industry for protecting coastal sites'....Fukushima?

Fission power stations like Fukushima Daiichi can always have the risk of a run-away reaction, since the fission process occurs naturally on the earth. However, fusion reactions only occur automatically if you have the ultra-high pressures at the cores of stars; tokamaks can sustain a fusion reaction only if the gas density is ultra low (less than one ten-millionth of air at sea level) and the temperature is ultra high (ten times hotter than the sun's core): the strong magnetic fields of a tokamak ensure that the plasma is kept away from the tokamak walls. If any of the fusion conditions in a tokamak fails, the reaction stops: it can't occur naturally on earth. Moreover, a tokamak in any event can only hold enough fuel for around 10s of operation, whereas a fission power station can hold weeks or months of fuel. Hopefully you can see now why a Fukushima-type runaway disaster couldn't possibly occur in a magnetically confined fusion reaction (ie a tokamak).

I understand the process, but fusion is used in nuclear bombs and is uncontrolled once initiated

Good to raise this – the magnetic confinement fusion (MCF) process in the STEP reactor can't initiate a chain reaction, and has no weapons application. Fusion bombs are essentially compressional: conventional explosives symmetrically placed about a cold fuel pellet produce a compression not

unlike that in stellar cores, and that compression triggers a fusion reaction, causing an explosion of the compressed material and subsequent reactions that release energy through the design of the bomb components.

MCF uses ultra-low-density material and high temperatures to harness fusion – conditions that can't lead to an uncontrolled reaction. Please be assured that there is no connection between STEP and a fusion bomb, and no possibility of an uncontrolled chain reaction.

This project must therefore include a pressurised system that converts heat energy from the reaction to electrical energy probably through water and turbines etc - is this the case for this design?

Yes, there will be a conventional steam turbine driven by the heat from the fusion reactor.

Is there any radiation by-products and consequently any risk to the environment or workers? Also seems to require a lot of energy to operate. Is there a size below which it uses more power than it generates?

Please give us an idea of the radiative materials produced in the process and end of life?

There are no radioactive waste by-products from the fusion reaction itself – it converts hydrogen to helium, and helium is the waste. The process will mean that the vacuum vessel itself will become irradiated (from the neutrons), and as it reaches the end of its useful life, the vessel will be removed and stored on site as intermediate level waste – similar to a medical isotope facility.

A replacement vacuum vessel can be installed, and the site returned to full operation. After a period not too much longer than its operational lifetime - certainly very short compared to any fission process - the stored vessel can be recycled into steel for other products – including a fusion vessel. The input power required is to service the cryogenics (for the super-conducting magnets) and other ancillary services, plus to initiate the burning plasma; after that it will produce net power for the grid. STEP is designed to be the correct scale for net energy delivery.

Only the vessel at the end of its life constitutes intermediate level waste; there are no radioactive by products produced by the fusion process.

Will this proposed fusion reactor produce any radioactive materials that will have to be disposed of either during life or at end of the project's life?

The fusion reaction produces helium as the waste product, and neutrons as the main energy source. These neutrons are captured in the lithium blanket, heating it up and allowing this heat to be transferred to a steam turbine for electricity generation (there are also additional possible applications of this heat).

Some of these neutrons will react with the lithium to produce more tritium, which can be used as fuel for the reactor (in fact, the expectation is that STEP will produce its own fuel in exactly this way). Those neutrons will irradiate the steel vacuum vessel itself, and so eventually – when it has reached the end of its operational span – the vessel will need to be stored as 'intermediate level waste': this

can be done safely on-site, and does not need the extensive storage facilities and protection that nuclear waste from fission reactors demands.

After a period not too much longer than its operational lifetime, and very short compared to any fission process, the vessel can be recycled into a new reaction chamber (or other application).

There are no radioactive by-products at any stage, and the vessel is no riskier than any large-scale manufacturing plant at end-of-life – in fact, this is similar to radioisotope production for medical therapies (eg cancer treatment or CT scans).

What about a conventional explosive problem from the nearby explosive factory?

A good point: the STEP team have already been in touch with HSE regarding the COMAH zones associated with other industry on the site and what might be possible. Should STEP come to Ardeer, it will only go ahead if HSE deem it safe.

The Health and Safety Executive will have both their own regulatory powers and full input into any planning decision regarding the siting of STEP at Ardeer, so please rest assured that the explosive risk from the other factory will be fully taken into account.

What size of safety zone does a fusion plant need? There are plenty of residents near to the peninsula who will be concerned about the impact a fusion plant would have to their ability to continue to live where they currently do.

It's unlikely that the STEP site will need to be licensed in the same way as a nuclear fission plant. The government's recent consultation on fusion regulation recommended that the Health and Safety Executive and Scottish Environmental Protection Authority will be the regulating bodies. It is currently not anticipated that there will be a need for a safety zone outside the NPL land holding on the Ardeer peninsula.

Fusion relies on fission for tritium to get started so can't be completely separate.

Actually, fusion generates its own tritium, so this is not entirely correct; there is no co-requirement for fission to make fusion a success.

There is only a very small amount of Tritium available worldwide. Where will the additional tritium needed for this plant be sourced from?

Where are the other sources of Tritium from if they aren't from fission?

Note that fusion will generate its own tritium supply via neutrons interacting with the Lithium blanket – STEP should generate more than enough to satisfy its own needs; similarly, ITER.

Fusion reactors breed their own tritium using the reaction between lithium in the reactor heat-exchange blanket, and the neutrons produced by the fusion reaction itself. It's anticipated that a fusion reactor will generate more tritium in this way than it consumes.

Are there alternatives to Tritium if it is in short supply?

UKAEA don't anticipate that tritium supplies will be problematic- see responses above.

We might disagree about whether Fusion is a renewable energy source

I hope not: given the tritium generation via the lithium blanket around STEP, I hope you will agree that there is no carbon in the fuel cycle, and that there is no waste product except for the reaction vessel itself (apart from the Helium gas, of course)

Where will we source the tritium to initially fuel this plant?

This is to be resolved, but there are a number of possible sources – including ITER, since fusion can generate its own tritium.

Bit alarming that you do not know where the fuel is coming from?

Please don't be alarmed: there will be a requirement for an initial charge of tritium – hopefully sourced from ITER, but the tritium sources will be assessed closer to the time when needed; after that, STEP will generate its own tritium. Deuterium is widely available from water – 1 part in 6000 or so of seawater contains deuterium, and lithium is widely available in both seawater and as a terrestrial mineral (about 20mg for each kg of rock).

Doesn't Lithium usually come from Chile? How will you find a sustainable source, could it be local? And if it is going to come from Chile, what will power it getting here?

Lithium may well come from Chile, too – it's the world's 25th most abundant element. There is about 20mg for every kg of rock anywhere, on average, so there are no geographic/political restrictions on sourcing lithium; it's also available from seawater (about 2 parts per million, estimated at 230 billion tonnes)

Would it not be better situated in a remote area that is already a nuclear site such as Dounray etc?

A fusion power station is intrinsically safe – in fact, fusion sites are likely to be controlled by the HSE, rather than a nuclear regulatory board (the exact regulatory framework is being decided at the moment); fusion sites do not need a nuclear licence.

In keeping with any safe large-scale industrial enterprise, it's best to be located where there is space and a workforce – and a location where the workforce want to live and raise their families. Given that STEP is a power station, it is also best located where the consumption of that power can be close, to minimise transmission losses. There is no need for a fusion power station to be built on a former nuclear fission site.

The EU ITER project is much further ahead and on a much bigger scale. Would it not be a good idea for the UK to collaborate with the rest of the EU to get to practical, energy-producing Nuclear Fusion?

Indeed: the UK is directly involved with ITER, and playing a full role as one of the 35 participating nations. The UK is the host to JET – the world’s largest and most successful fusion experiment, and the design predecessor to ITER. STEP will learn valuable information from the early operation stages of ITER (due to begin operation in 2025/6). It’s important to note that STEP is a different design, though: STEP is a spherical tokamak, so more of a compact ‘cored-apple’ shape than the very large doughnut of JET and ITER. The superconducting magnet coils required for STEP are smaller, making it quicker and cheaper to build without compromising on its power capacity. ITER is designed as an experimental test-bed, and is not intended to be a power station; STEP has power generation in its fundamental design remit.

Why do we need a prototype fusion plant here when this is what ITER does?

ITER is not designed to be a power station: it’s an experimental reactor designed to demonstrate a set of particular outcomes, including break-even power generation, materials testing under fusion conditions, and safe operation. STEP will be designed not as an experimental facility, but a prototype power station, based on learning about its predecessor (MAST-U), and also on experience gained from ITER.

The ITER fusion test plant in France is not due to be fully operational till 2035, even if it works. How can you start detailed design once you have the information from that and then have this reactor running in 2040?

Key here is design: ITER’s design was finalised a long time ago, and construction will be complete by 2025. There is then a campaign of experimental operation, gradually increasing power, until full power operations in 2035. Hence there will be the opportunity for a significant amount of learning from ITER before STEP is functional. Note also that MAST-U, the design of which is the basis of STEP (not ITER), is already operating, and will continue to do so.

So, is it for power generation in North Ayrshire or as an experiment?

Is it intended that this proposed experimental nuclear fusion reactor sited at Ardeer will input power to the grid and supply electricity? Or is it purely experimental?

STEP will be a prototype power station – in other words, elements of the design may be revised as operations suggest better ways of achieving performance.

It will generate power for the national grid, but not necessarily continuously: being a prototype, the first of its kind in the world, STEP will offer the operators the chance to explore how to optimise such a facility to get the most out of the fusion process: STEP can do more than just heat a steam turbine: the high operating temperatures of STEP can supply high-temperature processes directly (for example glass making or cement manufacture) in a carbon-free way. STEP is intended as a prototype for a fleet of fusion power stations (not just in the UK, but across the planet), and so will evolve as

more experience is gained from operating such plant. It is not purely experimental in the way that ITER is.

What's the proposed economic case and funding model?

The over-riding imperative is to broaden the base of low-carbon power generation, excluding nuclear fission. The funding model for STEP specifically is likely to be a combination of public and private investment.

What are the three top programme/project risks associated with this development?

As with any large-scale infrastructure project, the risks are to do with timescale slippage, cost overrun and unforeseen difficulties with the site having a knock-on effect on the construction. Achieving fusion is not thought to be a major risk, since this has already been demonstrated several times; refuelling is probably the biggest technical challenge, but experience from MAST-U gives confidence that this challenge will be met.

It's important to bear in mind that a fusion power station has no toxic spent fuel to have to store/reprocess, nor has it to bear the cost of an extensive and expensive decommissioning process – these are the major costs that enter the up-front budgeted costs of producing fission power, and cause such controversy on the unit cost of power production from eg Hinkley Point C. At this early community consultation stage, the final design process for STEP is not completed, since the local conditions pertaining to the selected site will have implications for the final power station design.

Cost overrun caused by e.g. unforeseen complexity or supply-chain delays are always a significant risk factor in all large-scale infrastructure projects. Please be assured that UKAEA and its engineering consultants are experienced in construction at scale, and will account for such risks when the design is finalised.

Can you confirm this reactor uses the nuclear fusion process and is intended to produce more energy than it uses to sustain the reaction?

Yes indeed: it is intended that STEP will break-even and produce net power -100MWe minimum; it is not an experimental facility.

Are there plans for the building if the prototype does not work? Could this just be another abandoned building?

The STEP team are absolutely confident that this machine will work – based on many years of investigation of the technology, including JET and MAST-U at Culham Laboratories. This is a new and exciting venture.

Will this proposed system actually contribute to the base electrical load?

When STEP is operating as a power station, it will contribute to the base load; note that STEP, being a prototype, will be subject to periods where it is being tested and developed, and so may be offline at these times.

How will you get Climate Change to wait until the second half of the century?

Part of a balanced response to ensuring we have dispatchable power available to replace our fleet of nuclear fission reactors and gas-fired power stations in order to meet our net zero targets: fusion has a part to play in the overall basket of solutions – we need every resource we can muster.

How can you claim that this will have an effect on catastrophic climate change, since we need to reach zero carbon emissions way before this plant will be in operation?

There needs to be a forward strategy on how we maintain carbon zero, but yet address the increasing power requirements of the earth's population. The scale of the problem is enormous: just as our fission reactors are retiring from service (in Scotland, nuclear fission provides about 10-20% of our carbon-free power generation), transport and domestic heating is being electrified, so increasing the demands on electricity generation.

The trick here is to balance as many carbon-free energy sources as possible to deliver the power required, including power-on-demand for when the weather is variable.

What happens if it goes ahead and in the intervening decades a reason arises for this new technology not to go ahead?

This is not entirely a speculative project: there is every reason to be confident that all the technology will work, since STEP will be based on MAST-U, a very successful experiment at Culham Laboratories.

There is no doubt fusion can be achieved – it has been achieved several times already, in JET; the remaining obstacles to fusion are (i) trapping the heat and using it for electrical power generation; (ii) refuelling the tokamak to ensure continued operations.

MAST-U researchers have recently proved that (ii) is now feasible in a Spherical Tokamak (a design pioneered by the UK, which is cheaper and easier to build than the conventional doughnut-shapes of JET and ITER); there is every confidence that the lithium blanket will perform as expected, providing the necessary high-temperature handling that will allow a steam turbine to operate efficiently, and also offer possibilities for other uses – such as cement manufacture or glass making – industries that need high temperatures in manufacturing, but are real challenges to finding alternative, carbon-free energy sources.

Taking into account the cost of building the plant; the relatively short life it will have; and the cost of decommissioning the hugely radioactive buildings and machinery, what will be the actual cost of electricity per unit?

Until the design phase is completed (in which the site selected has a fundamental role), then the final cost can't be determined. The assumption in the question of a short life is unjustified.

This is called cheap electricity but the cost to build, per megawatt, is at least 20 times the cost of Whitelees Windfarm

It's worth noting that Whitelees occupies more than 50 times the area proposed for STEP, but its maximum electricity generation is only 3 or 4 times the minimum of STEP. However, we shouldn't view this in a negative competition: they are both critical to the development of carbon-free electrical power for the people. We need to have a range of options for power – including a capacity that can be switched on regardless of the prevailing weather.

Building the site also has a large carbon footprint

UKAEA and NAC are both committed to minimising the carbon footprint of new buildings, using sustainable practices. The reality is that we need to ensure we have the generating capacity that helps us function, but keeps carbon out of the cycle.

How does this plan fit in with the Scottish Government's policy against new nuclear?

The SG energy policy is against nuclear fission, but has currently no stance on fusion; it is anticipated that this policy will be refreshed to account for this new type of power generation.

What if we gain Independence from the rest of the UK?

Considering the timelines what thought has been given to potential Scottish independence?

This is a reserved political issue – the STEP siting process is concerned only with the technical realities of choosing the best site, irrespective of politics. Ultimately, the choice of site is made by the UK Government.

Can you reassure me that the public will still have access to the beach and dunes for leisure purposes?

Apart from certain construction stages that could be disruptive (for example, if bringing in heavy equipment via the sea), there is no intention at all to prevent leisure use of the beach. There will be no disruption to the dune system.

How can you improve on nature's regeneration of the Ardeer peninsula?

Assuming that there is a community desire to resume some industrial activity on a fraction of the site currently left fallow, then any transient disturbance that construction inevitably causes can be mitigated by helping with the full natural evolution of the remaining untouched regions.

I am concerned that you get permission to go ahead and then its abandoned and we have lost our natural environment?

It would be devastating to everyone involved if the project was awarded and then abandoned – but bear in mind that the STEP requirement for land is less than a quarter of the NPL holdings on Ardeer – STEP will not touch the majority of the land

Ardeer may have been industrialised in the past, but even that was quite sympathetic to the local habitats. Now nature has done an amazing job of regenerating the area by itself. Why not just leave it alone and keep it as a nature reserve?

That's a perfectly valid viewpoint: what is happening here is that the community is being asked if they would be interested in redeveloping a small part of Ardeer site to host a fusion power station. The community will have to weigh up the impact that this would have on jobs and future prospects for young folk against leaving Ardeer alone.

The Ardeer peninsula is home to more than 1500 different species of plants and animals, a number of which are nationally rare. How do you plan on addressing the impact an operation of this size will have on the local environment?

STEP is inherently an environmentally conscious programme, and UKAEA seeks to optimise environmental performance across programme and plant design. Full consultation with all relevant organisations and parties will be undertaken to ensure this.

Have you also considered the fact that the land may be contaminated from the explosives factory? Have you considered that any land works in the area may create a lot of additional contamination and create further damage to the natural habitats? There is a designated SSI on the peninsula that needs to be protected.

A full investigation of the land condition will be undertaken if the site is selected; the initial assessment (based on records) has not revealed any showstoppers in terms of existing contamination. The SSSI is not part of the land under consideration, and so will not be touched. Moreover, the proposal for STEP would only take a fraction of the NPL land holding.

How great is the risk of contamination from Industrial waste already on the Ardeer peninsula which will be disturbed during construction?

That is something that the full site survey would address.

For the future, will there be a EIA undertaken for the site, as Ardeer Peninsula is one of the most biodiverse sites in Scotland and this information is readily available?

Yes, an EIA will be part of the full planning process that will be undertaken if Ardeer was selected as the site for STEP .

There is evidence of erosion of the Ardeer peninsula by the sea. How has this and the expected rise in sea levels been taken into account in the planning for the plant?

The Ardeer Peninsula might be at risk from rising sea levels due to climate change and from the pictures it looks like part of the building will be below ground level - can you explain your risk assessment to us?

Good point – the whole peninsula will need protecting against rising sea levels, irrespective of STEP

The artist’s impression of what STEP might look like doesn’t take into account any prevailing local conditions – it had to be produced before the site competition was started. Any final design will be tailored to the selected site, and the prevailing conditions.

What would happen if the site goes ahead and becomes flooded by sea water?

The intention is to have minimal effect on any natural resources – remember, if STEP comes to Ardeer, it will only use a fraction of the available land holding, and no environmentally sensitive areas will be damaged – including the sand dunes

Would protecting the site put the rest of Ardeer at greater risk?

If this is a reference to flood protection, then the answer is no: it is not consistent with local government or environmental policy to protect industrial premises at the expense of the rest of the neighbourhood (domestic properties etc). Protection measures must always meet the approval of the appropriate authorities.

Ardeer also has tourists visiting - will this impact?

It’s important to remember that STEP will only use a fraction of the Ardeer peninsula; the rest will be untouched. There will be some new infrastructure, including an upgraded junction to the A78 and possibly restored railway sidings, so the impact on traffic should be minimised. UKAEA are committed to sustainability across all aspects of the project, including transport.

Personally, living at Ardeer, the thought of the disturbance in terms of noise, to the landscape and nature, lack of infrastructure re roads, housing all around it really concerns me.

That’s understandable: however, the Ardeer site is huge, and hopefully the disturbance from the construction will have a minimal impact on the community.

With one main road in and out of Stevenson's Ardeer peninsula over 1000 workers will cripple the whole community.

Direct access to the Ardeer site via an improved junction on the A78, plus a restoration of currently disused rail sidings, should help mitigate the impact of construction and operation on the site; moreover, the marine access will also help with delivering large components. It's in no-one's interests to bring transport and communications to a standstill; please be assured that the logistics will be handled competently.

Will there be a process of generating a local workforce if we win the project rather than parachuting in the experts?

There will be a real chance for local supply chains and manufacturing to play a significant role in the construction. The Universities and Colleges have all agreed to work together to maximise the locally available training for the required workforce, at all levels, and at all stages.

Any industry returned to North Ayrshire would be exciting - a more sustainable, cheaper and safer option more so.

Indeed – and STEP could initiate a major innovation revival on the peninsula

Couldn't we provide fabulous training and employment opportunities in investing and improving renewables?

Let's do both: this isn't an either-or – we should try to bring as many opportunities to Ayrshire as possible. What we hope to show is that STEP is possible at Ardeer, and can bring so much more with it.

North Ayrshire needs employment now, why are we looking at a 21 year programme instead of one that helps local people now?

It's true that STEP is targeted to be functioning by 2040, 18 years away, but there will be a STEP presence and activity from 2023 on the chosen site, and site preparation will begin shortly thereafter. The site preparation, infrastructure development and construction will continue throughout mid-2020s to late 2030s, so employment will be available continuously through those phases, and then the operational phase of STEP will require a new workforce.

I believe that Skills Scotland and the Glasgow Universities together with the SQA have agreed in principle that should Ardeer win this project, that they would create an integrated, cross- level curriculum development process

Yes indeed – cooperation on delivering training and education on this scale is unprecedented: all the further education colleges in Ayrshire and Glasgow, plus all the Glasgow City Universities, have agreed to work together with SDS and employers (including STEP) to provide the most comprehensive programme for training and education to maximise the local opportunities for developing the best workforce possible.

Would you be looking to create targeted training at local colleges and universities and help fund this too?

Definitely: the 4 Glasgow-based universities, and the further education colleges in Glasgow and Ayrshire have agreed to form an advisory panel, with Skills Development Scotland, and industrial employers/agencies to ensure that the training and education offered will be as comprehensive as possible to develop a local workforce for all aspects of STEP and any associated industry that is attracted to Ardeer by STEP. Cooperation on this scale – across the education, training and employment sectors – is unprecedented, and serves to underline how well we can create joined-up thinking here to serve the community.

Why has the estimate of jobs provided for the plant risen from 300 to 4500?

There seems to be some confusion in the question: the estimate for construction jobs is 2500-3500, and for operations 600-1000; in each case between 2.5% and 5% will be apprentices, and a similar number will be graduates.

Wouldn't any infrastructure project of this size provide as many employment opportunities?

Perfectly possible – STEP is the one currently being discussed: it will help with low carbon power generation & net zero targets for Scotland, and bring a world-beating technology to Ardeer. Hopefully it will attract other innovation to the site.

How much will the 'full consent process' help us if the Secretary of State choses this site. Won't it be a done deal?

No – it will only initiate the full planning process.

But the only chance we have to make sure it doesn't happen here at all is now?

If the planning is refused, then the project will go elsewhere.

Who will own the land used for this project? Will it continue to be owned by NPL, will there be planning input or will the hotly disputed SDO (Special Development Order) continue to be in place, if it doesn't get overturned by Holyrood?

UKAEA are committed to the full planning procedures for STEP – the SDO will not feature in that consideration. STEP is open to either acquisition or lease basis land access, but must be able to access site with enduring certainty, and on appropriate commercial terms.

A special development order from 1953 exists for Ardeer. Does that not give Ardeer advantages over other sites?

UKAEA are fully committed to a full planning procedure, regardless of any special local development orders. The Ardeer SDO is not planned as featuring in any aspect of the planning for STEP in Ardeer.

With the SDO, you can ask us all you like, but what happens on NPL doesn't require planning but if the SDO is still in place... what will all the community consultation and so on actually mean?

As mentioned earlier, the SDO is not a feature of the STEP process – and neither is it the motivation for investigating Ardeer as a potential STEP site. UKAEA is committed to the full planning process at whichever site turns out to be the selected one.

Could this heat and water be used to create heating for homes in the area?

So, could some of this clean heat be used in Council housing?

Yes, indeed: the heat generated by STEP will be able to be used in many ways, for example in cement manufacturing or glass making: it's the key aspect of fusion that it can provide very high temperature coolant for multiple applications, including (but not limited to) driving steam turbines for electricity generation.

How would security be ensured and who will provide it?

These operational matters will be addressed when the site is finalised.

Which company is designing the reactor?

UKAEA is in full control of the reactor design

Would this affect the plans for the extension of the maritime museum on the Ardeer peninsula?

No, the activity is not on that land.

What are the dimensions of the buildings you propose?

Until the design phase is complete, and therefore the particular site properties are known, the final layout of the building can't be confirmed.

The Big idea turned out to be a bad idea...will this?

No! The Big Idea – a celebration of past ingenuity and existing technology – was not a bad concept at all (there are science centres all over the country); STEP is a future technology – a dramatic innovation that will be world-changing. Ardeer can rise to that challenge!

What is the date that a recommendation of the choice of site will be made to the Secretary of State for energy?

The current plan is that UKAEA will submit a recommendation to the Secretary of State in the spring, with a final decision made by the end of 2022.

If you are going to make a recommendation to the Secretary of State in a few months won't he require more detail than you can provide now?

The recommendation to the BEIS Secretary of State will initiate the detailed site survey and planning review that will provide all the answers.

What is the process for further consultation?

All feedback is welcome at any time; a full planning process will be initiated at the chosen site, and the relevant community consultations carried out then

Will further consultation be in a more accessible form?

Hopefully everyone who would like to engage is offered the chance to participate in an acceptable format – there are paper copies of the documentation, and feedback postcards that can be sent by conventional mail. The full planning process will provide a spectrum of opportunity for all.

When is the next part of the consultation with the public?

The STEP engagement events with UKAEA are now over, but communication with the Fusion Forward Ardeer consortium, which includes North Ayrshire Council, NPL and University of Glasgow, is always welcome.

It is difficult for the local residents to hear that our local environment where we live is being planned for a project which is so large and has such an impact on us but there are so few details about how it will be designed and work.

Please be reassured that this is early engagement, precisely to take on board comments and misgivings, and to offer clarity where possible. This isn't a planning application, but instead an early consultation and opinion-gathering exercise.

How do we object to these plans? It has been a bit surprising that we first heard about it after the Ardeer Peninsula was put forward as an option.

These are just the early stages of exploring if it's even possible or desirable to locate STEP in Ardeer: this is an early-stage community consultation – not a planning process.

If Ardeer is selected as a possible STEP site, then the full planning consultation will begin. It's unusual to have a pre-planning consultation exercise like this one – hopefully you will appreciate the good

intentions from UKAEA in getting early engagement with a possible hosting community, to discover what the perceived problems are, and testing local opinion before even initiating a planning application.

If we have objections as Ardeer as a site do we direct correspondence to the Secretary/UK gov or Scot gov?

If Ardeer is chosen, then a full planning process will be followed, with all the opportunities to register input at all levels (local, Scottish and UK governments).

Fundamentally you are asking the people of Ardeer and surrounding area to be part of a very expensive science experiment with little practical gain?

That's not a fair assessment: this isn't an experiment, it's a prototype zero-carbon electricity supply; the practical gain is a power station that meets the aspirations of net zero using a world first in technology.

Ardeer would be the pioneers of a future power generation technique that will help transform our carbon-based system to one that will be sustainable. Given the increasing electrification of domestic heating and transport required to meet net zero targets, we need to develop as many power sources as we can.

With the closure of all Scottish coal power plants and the very recent closure of the local Hunterston B Nuclear power plant, I personally feel that the development of the next generation of power plant at Ardeer is a massive opportunity for Ayrshire. I would like to understand how businesses and local people like myself can support the development team to help bring the plant to Ardeer.

We have had consultation meetings with industry (local and regional) and training providers, all echoing your enthusiasm. We want to encourage all comments and participation - to ensure that the community is aware of the opportunity here: we are in no doubt that this will be a fantastic development wherever it is located, and we hope that will be Ardeer. Please don't hesitate to help!

Having been to ITER a number of times, and worked in fusion for over five years I am hugely excited by this proposal from a local perspective. Fusion is a completely different proposition from conventional nuclear. It presents a huge opportunity for climate change and also to generate high value, highly skilled local jobs.

Indeed – there's a lot to be excited about: jobs, climate, new technology

I am an enthusiast, but I am worried about this Ayrshire location

Please remember that STEP in Ardeer would only occupy a fraction of the NPL land holding at Ardeer, and UKAEA are keen to minimise the environmental impact: they are committed to a safe, sustainable and environmentally responsible approach to all that they do.

I would commend the UKAEA for being brave enough to open themselves to public involvement at such an early stage of a project. Not very common at all. I don't think we can expect to have answers to a lot of these questions. My understanding is that to develop a sustainable energy supply we need to look at and explore lots of options.