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SPENT FUEL SOLUTIONS
INFORMATIONAL WEBINAR: FRENCH REPOSITORY UPDATE
Via Zoom
TRANSCRIPT OF MEETING
September 3, 2025

1 SPENT FUEL SOLUTIONS

2 INFORMATIONAL WEBINAR: FRENCH REPOSITORY UPDATE

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Transcript of video-recording meeting via Zoom
commencing at 11 a.m., Wednesday, September 3, 2025.

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1 WEBINAR SPEAKERS:

2 CHRIS WAHL - (EXECUTIVE DIRECTOR OF SPENT FUEL
3 SOLUTIONS)

4 DOCTOR SVEN BADER - (TECHNICAL CONSULTANT WITH
5 ORANO FEDERAL SERVICES)

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1 Via Zoom, Wednesday September 3, 2025

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3 CHRIS WAHL: Good morning to those of you that are
4 on the West Coast and good afternoon for those of you
5 that are in the middle part of the country on the East
6 Coast.

7 It's nice to have you again.

8 We appreciate you participating in our webinars.

9 I see that we have folks populating the participant
10 room and that's wonderful.

11 I'm going to give it a quick second to get started,
12 but very happy to have you here.

13 And we have a very exciting topic to talk about in
14 the world of spent fuel.

15 And we have a great guest and Doctor Sven Bader
16 that is going to join us, that has joined us.

17 And we're going to get started here in about one
18 minute.

19 So just give us a second to get all the technology
20 going and then we'll be rolling, rocking and rolling here
21 in a moment.

22 It's hard to believe it is September 3rd, though I
23 will say it sure seems to have flown by.

24 So Jessica, if you want to give me the thumbs up on
25 when you think we're ready to go if we have a good look,

1 ok, it sounds like we are ready to go.

2 So technology in place and we're going to get
3 started.

4 So good afternoon.

5 Good morning again.

6 Thank you for joining us.

7 My name is Chris Wahl and I serve as the executive
8 director of the Spent Fuel Solutions Coalition.

9 We're very pleased to have you.

10 Just a side note, this is our 10th webinar as a
11 coalition.

12 So it's a nice milestone for us to have reached.

13 And thank you to all of you who have made this
14 possible and participated along the way with us.

15 We've been a coalition for now three years and very
16 proud of our progress.

17 Four years, thank you, Jessica.

18 Very proud of the progress that we've made in
19 inserting ourselves into the national dialogue about a
20 potential solution for the spent fuel that we have in our
21 country.

22 So today we're going to talk about a very hot topic
23 in this industry about reprocessing.

24 The issue of reprocessing has been a public
25 dialogue, has been in the public dialogue and on Capitol

1 Hill now for a couple of years.

2 The most recent executive order from the
3 administration instructing the Department of Energy to
4 explore reprocessing and recycling has also heightened
5 the interest substantially in this item.

6 And as we are going along in our discussions with
7 stakeholders and leaders around the country, this topic
8 comes up on a regular basis and so we felt very
9 appropriate to delve a little further into it and provide
10 our interested parties with more information on it.

11 We're very fortunate to have an expert on spent
12 fuel reprocessing with us, Doctor Sven Bader live from
13 Charlotte, North Carolina, joining us.

14 Thank you, Doctor Bader.

15 We appreciate you participating.

16 He serves as a technical consultant for Orano
17 Federal Services.

18 And Orano is, if you don't know, a leader in
19 reprocessing.

20 The company operates the La Hague recycling plant
21 in France where they operate and reprocess 1,100 metric
22 tons of spent fuel each year.

23 As you may know, France is also in the process of
24 developing a deep geological repository known as Cigéo.

25 And once this is complete, the Cigéo project will

1 complement Orano's activities at La Hague by safely
2 disposing of nuclear waste.

3 For today's webinar, what we're going to do is
4 we're going to have Doctor Bader provide us with an
5 overview.

6 He's has some slides prepared.

7 And then as we normally do, we're going to jump
8 into a Q&A with him.

9 A few of you have already provided us with
10 questions for the doctor to answer, so thank you very
11 much for that.

12 Please continue to do so in the chat.

13 Jessica will help organize all of those and we'll
14 try to get to everyone's questions as we can.

15 I also have a number of questions that are already
16 pre-prepared that we will go through that I think will be
17 of interest to you.

18 And then as always, today's video will be posted on
19 our website at spentfuelsolutionsnow.com in a few days.

20 And we encourage you to share it with your
21 networks.

22 We'll also share it with ours as well.

23 With that, please join me in welcoming Doctor Sven
24 Bader and I will turn it over to you, Doctor Bader, to
25 provide us some more information on reprocess.

1 DOCTOR SVEN BADER: Thank you.

2 Thank you very much.

3 Thank you, Chris and Jessica for inviting me.

4 I appreciate the opportunity to talk about my yeah,
5 near and dear to my heart, reprocessing activities or
6 recycling and I'll hopefully clarify what the differences
7 between reprocessing and recycling.

8 I do want to go just, they've given me the
9 opportunity to do a short presentation on just an update
10 on what we do here at Orano and how France is kind of an
11 integrated life cycle for fuel and nuclear waste and just
12 show you how the what the benefits are for reprocessing.

13 So, so hopefully you can see my slides.

14 CHRIS WAHL: Yes.

15 DOCTOR SVEN BADER: Ok, great.

16 All right, so let's see here.

17 Good.

18 So and there's only six slides, but they're full
19 layers, so I apologize in advance.

20 So, so this is our La Hague reprocessing plant.

21 Right now, we're taking three inputs to that plant.

22 We take EDF fuel, which is the utility in France.

23 So that's, 25% spent fuel right now is being
24 reprocessed through this plant.

25 It's actually more than that.

1 EPZ is a small utility in Holland.

2 They have one reactor and they have a really unique
3 story, and I can talk about that at another time or later
4 in this presentation.

5 And then Kansai Electric Japan, we are starting to
6 look at their reprocessing, their fuel as well.

7 And when I say reprocessing, what we do is we
8 split, we take the fuel, we cut it up, chop it up and
9 then we have basically three streams that we recover out
10 of that.

11 The one that gets all the notoriety is the
12 plutonium, the yellow stream there, it's 1% of the heavy
13 metal of a fuel assembly.

14 So the meat inside the fuel assembly, about 1% of
15 that's plutonium.

16 The large majority is still uranium.

17 It's not the, the U-235 enriched of just around 5%
18 or so, but it's down to, you know, 2 or so percent
19 enriched.

20 In France, we, we covered this 95%.

21 We stored in southern France for future use because
22 in order to reuse it, you do have to ,re, re-enrich it.

23 And in order to do that, you need to have a
24 dedicated plant because you get a couple more uranium
25 isotopes in there that are unlike 235 and 238, there's

1 232 and 234 and 236 and, and some of that requires some
2 special shielding.

3 And then the last stream, the the last 4% of the
4 material, is this what we call the raffinate or fission
5 products and we vitrify that waste.

6 The vitrification canister is shown on the right-
7 hand side.

8 This canister is about 4 1/2 feet tall, 4 feet
9 tall, about a foot in diameter and we call it a universal
10 canister or a CSDV canister.

11 And then you can see next to it another canister
12 looks very similar, same size and all that.

13 The top lid's a little different.

14 This is our compressed metal.

15 So when you pull a fuel simply apart, you'll have
16 the cladding, you'll have the end fittings, you'll have
17 the grid spacers, all that gets compressed into these
18 canisters, super compact, super compacted into these
19 canisters and, and also prepared for disposal.

20 So what we do with the plutonium is we, so we've
21 reprocessed it, we separate it and now we recycle.

22 We actually take that plutonium and we put it into
23 MOX fuel.

24 We have a plant in southern France called Melox and
25 that plant is the one that produces the MOX fuel

1 assemblies.

2 It takes about eight PWR spent fuel assemblies to
3 create one MOX fuel assembly.

4 So in general the way we look at it is you take
5 eight PWR fuel assemblies, you get one MOX fuel assembly,
6 one enriched uranium facility assembly, one can of high-
7 level waste and part of a can of the compressed super
8 compacted wastes.

9 And so just some details on these.

10 Yeah, there's 1,600 metric tons is what La Hague is
11 authorized.

12 It was mentioned 1,100 metric tons is what we
13 usually recycle.

14 We're actually doing about 12,150 metric tons per
15 year at La Hague.

16 The attractiveness of these plants is the number of
17 employees.

18 So we have about 4,000 employees working on this
19 site.

20 It's about 750 acres.

21 And we take lots of visitors into our plant and we
22 spend a lot of money to keep the plant up to speed while
23 at the same time we're doing decommissioning.

24 Yeah, there, there are several lines at La Hague,
25 UP2-400 which is now being decommissioned, UP2-800 which

1 is operational and UP3 is operational.

2 So we, so while we're operating plants, we're
3 actually tearing down some plants as well.

4 So we have a lot of lessons learned from doing
5 this.

6 So we won't be repeating a, a West Valley or a
7 Hanford type problem where it seems like there's a
8 perpetual cleanup going on.

9 The Melox facility is in southern France, the La
10 Hague's northern France, Melox, southern France, another
11 thousand employees or so.

12 We produce about 250 MOX fuel assemblies there per
13 year.

14 It's a small footprint, 28-acre site and we spent,
15 you know 15,000,000 there to keep the facility
16 operational and they've produced over 3000 metric tons of
17 MOX fuel assemblies.

18 So what's the future of recycling in France?

19 So all our plants have finite lengths.

20 We announced last year that we have or going to be
21 reprocessing through the year 2100, 2100 and in the
22 process we'll also be putting in another spent fuel pool.

23 And sorry, I apologize for the acronyms.

24 You could see a footprint of our La Hague site
25 there on the left.

1 The red box is where the spent fuel pool is going
2 to go in.

3 It's probably also where the reprocessing line's
4 going to go in.

5 So if you, I call it La Hague 2.0, the French have
6 a different name for it, but it's basically the next
7 generation reprocessing plant and it will take some new
8 technologies.

9 What those exactly are, I don't know.

10 Yeah, we just started the design for this plant.

11 The unique issue though is that we'll also be
12 collocating the fuel fabrication.

13 So I showed you the Melox plant, which is in
14 southern France.

15 We're going to now build a a MOX plant in northern
16 France and that way we're not shipping material across
17 the country.

18 So how does this tie into the disposal program?

19 So the disposal program is known as the Cigéo and
20 you can see it on the slide there.

21 The actual name, the Centre Industriel de Stockage
22 Géologique and it's a repository located in in Meuse
23 Haute-Marne, which is actually east of Paris.

24 So there's a picture of Paris, the red dot's where
25 the where the repository is.

1 It's a clay repository, argillite.

2 Yeah, if I drill in a little bit, it's near the
3 town of Bure, which actually doesn't show up on that
4 picture.

5 But if you look at this, this is the detailed
6 breakdown of the site.

7 And Bure is located just on the just on the south
8 side of the of the planned repository, which is the red
9 square, the red shape in there in the center of that
10 picture.

11 Just a quick overview, what we do at Cigéo.

12 In 1991, Andra was created.

13 This is the group that controls the high-level
14 waste disposal program in France.

15 94, they did the survey across France to find the
16 best geologic options.

17 And then 1998, we built our first underground
18 research lab and this is the Centre de Meuse Haute Marne,
19 CMHM, which I use it and you can tell my French isn't
20 great, apologize.

21 But it's it's been an operation since the year
22 2000.

23 It's 500 meters deep or 1600 feet deep.

24 There are two shafts.

25 There's over 2 kilometers drifts, 1,000 boreholes

1 and 18,000 measurement points.

2 This is all to inform our license application and
3 allow us to do other research activity.

4 So here's some pictures of some of the underground
5 research lab.

6 Yeah, and some of the activities that they're doing
7 in order to demonstrate the safety of the facility.

8 In 2005, they released the dossier with the
9 feasibility principles of the site.

10 2009 they went with the choice of location for the
11 underground and surface facilities of Cigéo.

12 In 2016, safety options reports, a safety analysis
13 report essentially that we call in the United States or
14 SAR.

15 2020, declaration of public convenience and
16 necessities.

17 These are all steps that have been identified by
18 the French legislations.

19 And so they're going through a very systematic
20 approach.

21 And then in 2023, they submitted their construction
22 license application.

23 They're hoping by sometime this year or next year
24 that the decree will be issued by the French government
25 that allow us to actually use Cigéo as the repository.

1 So what does it exactly look like?

2 It's not terribly exciting.

3 It's it's, it's down in the hole.

4 You can see a ramp.

5 So you can see, here's the city of Bure, village I
6 should say.

7 You could see it's a ramp going down. And I'll show
8 you some more details on this a moment.

9 There are several shafts coming down as well.

10 And what's really noticeable is that it's not a
11 huge footprint.

12 And I'll tell you how large the footprint is in a
13 moment, but you could see there's only two types of waste
14 that are planned to be disposed of there.

15 The disposal for the intermediate-level long-lived
16 waste, which in the U.S. is equivalent to something like
17 akin to GTCC, Greater-Than-Class C low-level waste and
18 then the disposal for the high-level radioactive waste.

19 So those cans that I showed on the first slide,
20 yeah, the ones with the compressed super compacted waste,
21 that is the intermediate-level waste.

22 And then the high-level waste is the vitrified
23 glass.

24 You'll notice there's no spent fuel on here.

25 So just give you some idea.

1 So here's the the waste packages of what they look
2 like at the surface facility that that they've been
3 designing.

4 And some of the operations are all going to be
5 automated operations.

6 They are doing a lot of work on the ramp.

7 They've actually got a system.

8 So yeah, the concern of course is a runaway vehicle
9 going down, with the, loaded with the high-level waste
10 and crashing into the bottom.

11 So they're looking at, you know, all the braking
12 systems and so forth and they're in the process of
13 demonstrating this.

14 So these some of the tests have been going on the
15 the high-level waste packages are basically you could see
16 our cylinders in the center, the universal canister
17 surrounded by a concrete block.

18 Sorry, this is, sorry a low carbon steel block in
19 this case or basically a cylinder within a cylinder.

20 And then these will be disposed of in the on the
21 right-hand side, you could see they go into the
22 horizontal drifts for disposal with some spacers in
23 between for thermal.

24 And that the size of the spacers depend on the age
25 of the canisters.

1 Yeah, if we allow the canisters to decay longer,
2 the spacers obviously become shorter.

3 And then here you could see this is the
4 intermediate level waste, this is the concrete packs.

5 So there's two different sizes, the the four pack
6 and then the two pack.

7 And yeah, there's not much of this.

8 Yeah, you could, there's 20 cells planned.

9 These all will be stored vertically like this in
10 concrete liners and you can see the approximate space.

11 So again, notice there's no spent fuel, no spent
12 MOX fuel, there's no intermediate-level short-lived waste
13 and there's no low-level waste planned to be stored in
14 the near.

15 And that's all result of our reprocessing life
16 cycle activities that are going on in France.

17 So they only could be getting standardized waste
18 forms, the those canisters, which has really a
19 simplification on the safety basis, no criticality
20 issues, no need for international safeguards for
21 perpetuity.

22 So yeah, so there's there's a lot of advantages to
23 what they're doing.

24 So just want to show you the actual impact.

25 So yeah, this assumes 40 years of operation of each

1 of the nuclear plants in France, all PWRs.

2 And if, they, there's no reprocessing going on, the
3 footprint of the repository would be 14 square
4 kilometers.

5 If we do what we're doing right now, so we
6 reprocess the fuel once and we have end up with spent MOX
7 fuel.

8 So here's a picture of what the repository would
9 look like.

10 And now I've got a lot of area where spent MOX fuel
11 is being stored and that is a 9.2-kilometer square
12 repository.

13 So there is definitely some savings just from doing
14 the once through process of recycling.

15 If we go to the advanced recycles where we actually
16 recycle our MOX fuel, which is part of the plan for the
17 new, new plant that we're going to put in, you see the
18 footprints are significantly different.

19 So almost the you know somewhere, a four, a third,
20 to you know a fourth of the design of the repository gets
21 reduced, yeah, depending on how long these decay periods
22 are.

23 So we go from one with spent MOX to one where that
24 with just this smaller footprint with only spent, sorry,
25 with only high-level waste and the intermediate-level

1 long-lived waste.

2 And just for comparison sizes, you could see the
3 impact here of the relative footprint of the repository.

4 So significant cost savings.

5 But the point is there's still need, you still need
6 a, high need a repository.

7 So in addition to the space savings, you also get
8 to recover these materials for future use.

9 Potentially these advanced reactors come along,
10 standardized robust waste forms are produced,

11 There's no criticality hazard.

12 You have the opportunity to recover other useful
13 radionuclides or stable isotopes.

14 And most importantly, there's no repackaging.

15 So yeah, from bolted cast or welded canisters.

16 So a lot of benefits.

17 So just last slide, yeah, path forward going on in
18 France.

19 Yeah, the construction hopefully will and be
20 engaged here by 2027 at the latest.

21 They expect operation to start 2035 and then yeah,
22 final closure in the 2150 time frame.

23 So that's just a high overview of where we're at.

24 There's some a lot of fun facts out there what we
25 do.

1 But you know, basically one in 10 light bulbs in
2 France runs on MOX fuel from the La Hague plant.

3 So there's definitely benefits.

4 You still need a repository program, but one of the
5 another benefit I didn't point out is if you start
6 reprocessing now, it allows you to decay store that high-
7 level waste for even longer, which even further reduces
8 your footprint.

9 So, so those those are my slides.

10 I'm going to stop sharing at this point and take
11 any questions that you all might have.

12 CHRIS WAHL: Outstanding.

13 Well, thank you, Doctor Bader.

14 We really appreciate that.

15 We have several, several questions from the
16 audience already, but I'm going to start with and I will
17 get to those in a second.

18 And I want to remind everybody, if you do have more
19 questions, please drop them in the chat and Jessica and I
20 will do our best to get to everything.

21 I want to start with some basic questions though,
22 just to level set.

23 I I believe you covered some of this already, but
24 just specifically can you share with the audience just
25 the difference between recycling and reprocessing?

1 DOCTOR SVEN BADER: Sure, sure.

2 So reprocessing is the is is the process that used
3 to separate the elements from one another, the
4 constituents.

5 So yeah, Hanford did reprocessing and that the
6 intent there was to get the uranium and plutonium for
7 weapons program.

8 At La Hague, yeah, we're separating reactor grade,
9 not weapons grade material into, yeah, the uranium,
10 plutonium and then the and the waste forms.

11 And then recycling is taking that uranium and
12 plutonium and making it into a fuel.

13 So you're actually taking the product that you're
14 separating from reprocessing, making a fuel and then
15 putting it back in the reactor.

16 That's the actual recycling loop.

17 CHRIS WAHL: Thank you.

18 That's great.

19 And from your perspective, what are the benefits of
20 reprocessing, recycling spent nuclear fuel?

21 DOCTOR SVEN BADER: So, yeah, I had some on that
22 slide there.

23 There are, yeah, lots of advantages and you know,
24 and maybe we'll get to the disadvantages as well in a
25 little bit.

1 But yeah, first off is you're recovering this
2 material.

3 Second off, this recovered material can be used to
4 produce what we call U-TRU or MOX fuel.

5 If it's an oxide fuel and that will have a
6 performance, you can make it, you can add a little more
7 plutonium to it to make a bigger kick that basically
8 gives you performance similar to HALEU.

9 In fact, that's one of the models that's being
10 portrayed here in the United States is yeah.

11 What Oklo, for, doing, planning on doing is
12 recycling their fuel so that they can make U-TRU fuel
13 that is cheaper to produce than HALEU from reprocessing.

14 Furthermore, if we do reprocessing, yeah, that's
15 going to require more mining, more conversion, more
16 enrichment, so and more deconversion.

17 All that's expensive.

18 That'll increase the price of uranium, which makes,
19 yeah, bringing uranium from reprocessing in a lot more
20 attractive economically.

21 Yeah, reprocessing also gives you a nice solid
22 waste form.

23 You know, it's a vitrified glass waste form.

24 I don't have to worry about bending fuel rods or
25 fuel rods slumping over time.

1 Yeah, releasing their off their fission gases and
2 so forth.

3 So it's also standard form.

4 So yeah, once you get one glass form, you get
5 that's all you get those glass forms.

6 I don't have the 30 or 40 different size canisters
7 we have in this country that have to figure out how to
8 dispose of.

9 Yeah, so in that respect, to help simplify the
10 design of a repository, yeah.

11 By getting the uranium, plutonium out, I don't have
12 to worry about the criticality hazards that are often
13 dictate a repository design.

14 Yeah, right now we're looking at direct disposal in
15 the United States and there's a criticality hazard
16 hypothesized for several, several thousand years later.

17 Yeah, because the packages is eventually dissolved
18 and water gets in.

19 And if the assemblies are still in their current
20 condition, they'll go critical.

21 So, so it has that benefit, yeah.

22 Also you can recover other materials that.

23 Yeah, right now at La Hague, yeah, we just do the
24 fission products all into one bucket right now and
25 solidify that.

1 But you could do separations.

2 Yeah, we're actually right now looking at Krypton-
3 85 recovery and Americium-241 recovery at La Hague
4 potentially.

5 The Americium-241 is wonderful for space
6 activities.

7 There's not a lot of PU-238 out there for the RTGs.

8 So Americium-241 is a suitable, not as good, but
9 it's a suitable replacement for that and it's and it's
10 pretty bountiful in the fission products.

11 I don't have to repackage at a repository.

12 You know, if I get bolted casks, you know,
13 everything has to be repackaged.

14 If I get welded casks, it might have to be
15 repackaged to meet the the design of the repository.

16 And that repackaging can be quite a hassle.

17 Makes a lot of jobs.

18 Yeah, if you do reprocessing, it's a lot of jobs.

19 And make something like a consolidated storage
20 facility look a lot more attractive.

21 Yeah, consolidated storage facility, maybe 100
22 jobs, you know, add a reprocessing plant, it's now in the
23 thousands of jobs, so.

24 And also, again, I know people keep harping on
25 proliferation.

1 What's great about recycling is, yeah, if you take
2 that plutonium, you put it back in the reactor, you're
3 burning down those physical isotopes.

4 So you're actually making it less proliferate.

5 You're, you're, the even isotopes start building up
6 in your plutonium.

7 And those are absorbers for the most part, which
8 make it impractical to make a weapon out of a, a, a, a
9 nuclear weapon.

10 So, so that yeah, there's that additional benefit
11 because that's what the MOX program was intended in the
12 United States was to take that weapons grade plutonium,
13 make MOX fuel out of it and burn it in reactor.

14 And that way you're burning down your P-239.

15 So, so that's yeah, those are some of the benefits
16 probably.

17 CHRIS WAHL: Why, why don't you just keep going when
18 I mean, we'll, we have some questions are coming in from
19 your answers, which is great.

20 But just maybe one more question from me and then
21 I'll turn to the audience.

22 Why don't you just start or what, just continue the
23 conversation about what are the disadvantages from your
24 perspective?

25 DOCTOR SVEN BADER: Ok, so it's expensive.

1 So that that that is the number one hassle.

2 Yeah, with reprocessing is it can be expensive.

3 Yeah, France is, is recognizes it has no uranium,
4 so it needs to recycle, you know, fuel in order to defer
5 or some of the the needs from getting materials from
6 outside the country.

7 So, so yeah, it's an expensive endeavour.

8 Another disadvantage in the United States right now
9 is that the licensing mechanisms, if you want to build a
10 reprocessing plant, you build it under 10 CFR 50.

11 And if you got people here from the reactor
12 industry, you all know 50.

13 50 is what all of the reactors in the United States
14 are licensed under.

15 And there's actually some parts in there that are
16 actually for reprocessing and they're, they're
17 antiquated.

18 NRC did its own gap analysis in 2009 and found 23
19 gaps in their regulations for reprocessing.

20 And they've resolved many of those gaps.

21 But there's still a couple zingers out there.

22 They stopped their their updating of the
23 regulations, their rule making activities on this in
24 2021.

25 Yeah, some might say for the better, some might say

1 for the worse, but yeah, we've understood the interest.

2 They had limited resources and with all these new
3 reactor applications coming in, yeah, without a
4 reprocessing, some metal coming in, yeah, it it probably
5 made justification to can't stop that rule making
6 activity.

7 Yeah, the wastes is another one that's often cited
8 against reprocessing to in addition to the low level,
9 sorry, in addition to the high-level waste, the vitrified
10 waste in the compressed waste.

11 Yeah, we, we do produce quite a bit of low-level
12 waste.

13 You have to remember the activity in the spent fuel
14 is the activity.

15 Yeah, we're not reducing the activity, we're
16 segregating it.

17 In the process, we do create a lot of low-level
18 waste, most of it's Class A.

19 Fortunately in this country we have solutions for
20 class A, B and C waste.

21 So, so that this, yeah, this does increase the
22 amount of this waste, but it's also to the benefit of, of
23 something that's even more rare than a low-level waste
24 disposal facility, which is a high-level waste
25 repository.

1 So yeah, I mean, we, we, we clearly exceed the
2 Yucca Mountain authorization.

3 I think it was 65 or 68,000 metric tons.

4 Yeah, we're well beyond that now.

5 Not that that was an actual limit to the Yucca
6 Mountain's capacity, but that was what's in the Nuclear
7 Waste Policy Act.

8 So theoretically we should be working on the second
9 repository already at this point.

10 But if you do reprocessing, you can get it back
11 down to one repository.

12 So that so waste is another, proliferation is
13 always brought up.

14 And yeah, I would say in the future, we do not see
15 separation of plutonium as a as a good process.

16 Yeah, the optics are not good on that.

17 So the the three companies that are working the
18 United States, well there's more than three, but there's
19 three companies in the United States primarily working on
20 reprocessing, which are I'll do it alphabetically, Curio,
21 Oklo and SHINE, all three doing different approaches.

22 But if you look, I don't think there's not one of
23 them that's doing a, a separate plutonium stream.

24 It's always a coextraction.

25 So uranium and plutonium are getting extracted

1 together.

2 So, so it doesn't prevent proliferation, but it
3 does have the optics and it does reduce the the
4 attractive, the attractiveness of that material somewhat.

5 What else am I missing?

6 CHRIS WAHL: I think that's good.

7 I think that's a good summary.

8 Let's, thank you for that.

9 Let me let me get to a couple of audience
10 questions.

11 So one comes to us and the question is how does
12 this apply to the spent fuel situation in the United
13 States?

14 DOCTOR SVEN BADER: Oh, wow, that's a huge question.

15 So I mean, we have these executive orders that came
16 out recently.

17 There was four of them.

18 One of them really beat up on on reprocessing, or
19 not beat up, gave us the opportunity for moving forward
20 with reprocessing.

21 And how is that going to help?

22 Well, if you look at the original basis of what
23 spent fuel was going to was was going to be done with
24 spent fuel in this country, it was going to be
25 reprocessed.

1 So back in the 70s, we had West Valley, we had the
2 AGNS facility, Allied General Nuclear Services in
3 Barnwell, South Carolina, we had GE Morris, they were in
4 [unintelligible].

5 All were looking at reprocessing.

6 It fell out of favor.

7 Jimmy Carter basically put out an executive order,
8 said we will not do reprocessing.

9 And instead the Nuclear Waste Policy Act came out
10 to address the problem with spent fuel.

11 And so now Nuclear Waste Policy Act is is falling
12 on its face right now and is not helping us much.

13 Now we're moving back to reprocessing.

14 So we're almost like swinging the pendulum back to
15 what we originally was the case before we had troubles.

16 So we had the opportunity to recycle this fuel.

17 Yeah, there is, yeah, there's no issue with older
18 fuel or refresher fuel.

19 You know, each has its own advantages of of being
20 reprocessed.

21 Yeah, the main thing is, is making sure you have an
22 avenue or path on what you're going to do with what
23 you've separated from reprocessing.

24 So make sure you make that fuel for those next, you
25 know, for either the current fleet reactors or for the

1 next generation reactors.

2 Yeah, there's so much fuel and there's so much
3 plutonium, so much, so much spent fuel in this country.

4 I mean, we're the Saudi Arabia of spent fuel.

5 We have more than any other country in the world.

6 And, and probably, you know, yeah, if if you look
7 what we've reprocessed at La Hague, yeah, we're, we're
8 doing 1200 metric or up to 1600 metric tons a year.

9 We've got way more than that.

10 And La Hague's a big plant.

11 Yeah, I would think in this country would probably
12 want a small start with a smaller reprocessing plant,
13 start showing success of that and then you have
14 potentially, you know, elevate that in size, increase the
15 size like we do at La Hague.

16 We do work by 800 metric tons per year type of
17 processes.

18 So we have two processes right now.

19 So that's 1600 metric tons, but you can downscale
20 that or you can, you know, GNIB [unintelligible] looked
21 at these huge plants.

22 I think we're doing 3200 metric tons per year and
23 GNIB [unintelligible].

24 And so the costs were astronomical, yeah, we can, I
25 don't think we can go there.

1 There's just not the the appetite for that in this
2 country.

3 So, yeah, so there's plenty spent fuel.

4 It's not going anywhere.

5 We have this opportunity with the delay in the
6 repository program to potentially go back to the
7 reprocessing and see if it's if it's if it's a successful
8 path forward or not.

9 Yeah, the executive orders give us this opportunity
10 as well.

11 CHRIS WAHL: That's great.

12 Thank you.

13 Another question we have is what is the net volume
14 reduction compared to direct disposal and how much does
15 it add to the cost of fuel compared to once the once
16 through fuel cycle?

17 DOCTOR SVEN BADER: Ok so the volume reduction,
18 volume reduction, so I showed the footprint.

19 So that was surface area, that essentially is
20 volume reduction as well in France.

21 So that's a specific model.

22 How much does it do in the United States?

23 I, I, yeah, I could say maybe a quarter.

24 It depends on the repository.

25 So yes, some repositories are very forgiving with

1 heat.

2 I would say Yucca Mountain was one of those.

3 Other types of repositories are not very good with
4 heat.

5 Salt is a good example.

6 I think clay is probably also a good example.

7 And yeah, but granite, also does well with heat.

8 So did the footprint reduction depends on multiple
9 factors.

10 One, how much of that, yeah, what are you going to
11 throw away?

12 Are you only going to throw high-level waste away?

13 In which case you could see what the footprint
14 reduction was on the slides as presented for France for
15 clay repository, yeah.

16 Or am I going to, you know, throw a high-level
17 waste away with spent fuel, in which case, yeah, now I'm
18 increasing the footprint of the size of the of the
19 repository.

20 Yeah, but commonly when we talk about repository
21 footprint reduction, it's a quarter.

22 Now I, I think the, the questionnaire intentionally
23 put volume in there to try to catch me off here.

24 So volume is yeah, yeah, assume it's volume of all
25 the way.

1 So the volume of all the waste is comparable to
2 trying to dispose of spent fuel.

3 But yes, we have a lot of low-level waste as well
4 as produced at this.

5 I, there's several presentations I've made in the
6 past on this.

7 We have solutions for low-level waste in this
8 country.

9 So I don't think that's going to be a challenge to
10 to overcome.

11 Yeah, and so really you're looking at the high-
12 level waste reduction as the real benefit to from
13 reprocessing.

14 Now cost, that that one.

15 Ok, so that one, impossible to tell you.

16 Yeah, and, and the main reason is, is because in
17 this country we don't have one utility.

18 We don't have, yeah, a utility or a reprocessing
19 plant that works with, together with the disposal agency.

20 We have, you know, we don't have reprocessing.

21 We have a federal government that's running our
22 repository program.

23 And yeah, do you ask them for credit for, hey, I
24 just say to you, I don't know, \$2 billion on your
25 repository size because I'm only give you a high-level

1 waste now not spent fuel.

2 Do I get credit for that?

3 I don't know what the answer is going to be.

4 Yeah, maybe I think the executive orders are
5 pushing us in that direction.

6 But you also have people right now, all the
7 utilities for the most part, they're getting reimbursed
8 by the judicial fund for the the the their storage and
9 storage of their waste because the DOE's been in default
10 of their contract, their standard contract.

11 I think what's going to push us over the edge a
12 little bit is these advanced reactors because the new
13 standard contract, the amended standard contract, does
14 not allow you to sue the Department of Energy.

15 So the burden of the waste becomes the operator's.

16 And so no longer will we want to have spent fuel
17 sitting at these sites for long periods of time,
18 especially after reactors shut down and there's no
19 revenue stream coming in.

20 So yeah, yeah, and also, yeah, if we do go with
21 these advanced reactors that need HALEU, well, now I need
22 more uranium, more conversion, more enrichment, more
23 deconversion, all that's going to, you know, make the
24 price of this fuel go up, which makes reprocessing look
25 more attractive, but makes nuclear less attractive.

1 So, so we have to be careful in the balance here.

2 And there are, there are a lot of programs out
3 there looking at this fuel cycle analysis.

4 You know, T.K. Kim has got a dedicated program at
5 the DOE, is looking at these type of activities.

6 Challenges though are transition.

7 How do you transition from right now where
8 utilities are happy, sort of, although they're stuck with
9 spent fuel.

10 Yeah, but they're getting reimbursed from the
11 judicial government.

12 The antis are happy because there's no federal
13 program for disposal.

14 Yeah, The, the the DOE's happy because, yeah,
15 they're not having to fund this.

16 It's coming out of the judicial fund.

17 But that's a taxpayer liability.

18 Yeah, the Congress is kind of happy because, yeah,
19 the judicial fund's not scored against the general
20 budget.

21 So, yeah, that deficit that's produced there is not
22 going against everybody's record.

23 Yeah, so, so there's a lot of pseudo happiness
24 right now.

25 No one's completely happy and restoring the fuel

1 safely and securely at this point.

2 Yeah, so yeah, a disruption such as reprocessing,
3 yeah, yeah is that, is that what we're going to look at?

4 And, and the reproprocessors had to be motivated by
5 getting, ok, where am I going to get my revenue stream
6 from?

7 CHRIS WAHL: That's great.

8 So you know, we're, we're getting a lot of
9 questions.

10 This is awesome.

11 More than we normally get.

12 DOCTOR SVEN BADER: Sorry.

13 CHRIS WAHL: No, no, this is great.

14 But I do want to try to get to questions.

15 So I would say if we could maybe answer the
16 questions a little bit more directly that way we'll get
17 to more questions.

18 DOCTOR SVEN BADER: Absolutely.

19 CHRIS WAHL: I don't want people to be upset that
20 we're not trying, to feel like we're picking and
21 choosing.

22 But if we don't, by the way, get to everyone's
23 questions, we will make sure that we respond accordingly
24 and we will get them out and circulated.

25 So here's one.

1 What is the average, now I think you might have
2 covered this a little bit, but maybe more detail would be
3 great, what is the average number of high-level waste
4 glass packages slash metric tons spent nuclear fuel?

5 DOCTOR SVEN BADER: Yes, so the it's, I don't
6 remember the top number off of my head, but it's about I
7 think we can get you know when we take eight fuel
8 assemblies, we produce one canister of waste.

9 So each fuel assembly is about half a metric ton.

10 So that's about four metric tons producing a high-
11 level waste canister.

12 And I don't remember what the weight is, but it's
13 probably a one to four type ratio.

14 CHRIS WAHL: Ok, ok, good.

15 And here, follow up to that is are the containers
16 carrying the spent nuclear fuel to reprocessing facility
17 reusable without decontamination?

18 If not, what is the volume package that needs to be
19 disposed of?

20 Yeah, so at La Hague, we actually, you have the
21 same fleet of transportation casks that we've had for,
22 you know, probably a decade.

23 We're we're in the process of replacing them now.

24 But we don't need to decontaminate them because the
25 way we bring them into La Hague is we don't put them in a

1 pool.

2 We bring them up to a hot cell.

3 We hook it up to the hot cell and we actually bring
4 the fuel assemblies out and dry.

5 And you can actually observe this at La Hague, you
6 know, if you ever get a tour of La Hague, you can
7 actually see a fuel assembly pulled out in front of you.

8 There's a lot of lead shielding in front of you, a
9 lot of lead glass in front of you.

10 But you can see actually the air moving along the
11 particularly hot ones.

12 So, so there's, so the canisters, sorry, the casks,
13 these are bolted casks are used over and over and over
14 again.

15 Yeah, they do go into pools at the reactor sites.

16 So they are decontaminated when they come out of
17 the pools of the reactor sites.

18 And should we have a problem at La Hague with a
19 cask that had an incident along the way, we do have a
20 pool we're working unloaded as well, but we prefer not to
21 use the pool because we don't have to do decontamination.

22 CHRIS WAHL: Yeah, interesting, ok, ok.

23 This is a little bit of a longer one, so let me,
24 bear bear with me as I read through this.

25 You know, I the question from the the viewer was I

1 have often heard that reprocessing reduces the size of a
2 geological repository for spent nuclear fuel and high-
3 level waste by 30%.

4 What is a technical basis for this point?

5 Whereas the base is documented publicly and does
6 that estimated 30% include the added volume of waste it
7 needs to be disposed of as a result of reprocessing?

8 DOCTOR SVEN BADER: Yeah, So I think again, this
9 this, so hopefully the slides I showed you give you a
10 good reference point.

11 Actually in my slides, I give the references where
12 those came from.

13 So I can't e-mail the slides they're too big.

14 I put too many pictures in there, but yeah, I'd be
15 glad to share those references with you guys so you can
16 share them with other people.

17 CHRIS WAHL: We can work with you too to get that.

18 If you're, if you're comfortable sharing the deck,
19 we can, Jessica and I can probably figure out how to do
20 it in a PDF version that we could share with the group.

21 There's a lot of good detail in there.

22 DOCTOR SVEN BADER: Yeah, the problem with the PDF,
23 I got so many overlays over it.

24 CHRIS WAHL: Oh, yeah, yeah.

25 Ok, whatever we can do.

1 DOCTOR SVEN BADER: Yeah, but yeah, it's it's it's
2 it's a publicly shareable document, so or presentation.

3 So yeah, I have no qualms with that.

4 Yeah, yeah, that, that was a footprint reduction.

5 So you could see, yeah, it depends what you're
6 going to throw away.

7 If you're going to throw away MOX with just high-
8 level waste, it still gets you a savings if I don't, if I
9 just go straight to disposal, direct disposal.

10 Yeah, so I tried to show all the layers there.

11 There were three layers there.

12 Hopefully that shows you there.

13 And now if you want me to add to the low-level
14 waste, because everyone does add when I add low level
15 waste, these criteria.

16 Yeah, again, we have presentations that we've done
17 out there.

18 We'd actually did a study for the Department of
19 Energy on this and what the low-level waste streams were.

20 We did this with France and the UK and amazingly we
21 almost came up with the same answer.

22 So, so these they're pretty good numbers.

23 CHRIS WAHL: Good, ok, let me move to this one about
24 California and bringing this technology to the United
25 States.

1 I think that's a hot topic as well.

2 So one viewer says San Onofre has a footprint of at
3 least a two gigawatt nuclear fission power plant.

4 I understand that the science is still in
5 development.

6 What challenges must be overcome to bring the
7 demonstration reactor to California in the next 20 to 30
8 years?

9 DOCTOR SVEN BADER: I'm not sure I fully understand
10 that question.

11 So I'm not sure which demo reactor we're talking
12 about.

13 I've actually never heard anything recently about
14 anything going on the SONGS site, but I mean, I can talk
15 about the SONGS fuel in general.

16 So the SONGS fuel yeah came from three different
17 reactors.

18 So can it be reprocessed?

19 Yes.

20 Is it a challenge?

21 Maybe because there's different, the different
22 cladding that material there, that one point I think they
23 had stainless steel and they eventually ended at
24 zirconium.

25 We right now like to reprocess Zirc-based fuels.

1 We have done stainless steel fuels in the past, but
2 that requires some modifications to the plant and the
3 plant that's being decommissioned I believe is the one
4 that did that reprocessing.

5 So there's there's a bit of a challenge these
6 fuels, you know, just, you know, based on what the
7 cladding is, the fuel type, the burn up.

8 Yeah, and could that power another reactor?

9 Yes, absolutely.

10 Again, for every APWR fuel assemblies, I get a MOX
11 fuel assembly out of that.

12 So yeah, there's there's definitely a lot of fuel
13 there that can still be re-utilized.

14 CHRIS WAHL: Great.

15 So another question is, some questions about the
16 difference between the reprocessing for commercial slash
17 weapons grade as you were mentioning and it's obviously a
18 hot topic, of course, right.

19 So this one is how does reprocessing in France
20 relate to French nuclear weapons development since it's
21 being led, managed by the French government?

22 Right, so Orano is, does not, do any defense
23 processing.

24 So La Hague is a completely commercial reprocessing
25 plant.

1 So the best way I can contrast this is, yeah, we
2 take light water reactor, commercial fuel, PWRs and BWRs,
3 boiling water, pressurized water reactors and reprocess
4 that material and that creates what's called reactor
5 grade plutonium.

6 Reactor grade plutonium does not look like weapons
7 grade plutonium.

8 Weapons grade plutonium has Pu-239 and above 90%.

9 Can you make a bomb with something less than 90%?

10 You could, but I'm not a bomb maker so I don't want
11 to go into the details, but it's really unstable so I'll
12 just put a period on that.

13 So La Hague does, no, does not make any bomb
14 material for France.

15 There is a specific industry set aside in France
16 for supporting the defense-related programs and they're
17 independent of our commercial activities.

18 So, but the, the what Hanford was producing is
19 there, those weren't PWRs or BWRs.

20 Those were production reactors that were producing
21 fuel that was intentionally going to be dissolved to
22 recover the plutonium for making bombs.

23 And unfortunately what they did there is they,
24 they, they did all the extraction for the plutonium and
25 some of the uranium and then they threw all the rest of

1 stuff into tanks.

2 They didn't vitrify it.

3 They didn't process it or anything.

4 So that's why, you know, the footprint of, of, of
5 Hanford's actually somewhat smaller than La Hague, but
6 that's because we we do all of our [unintelligible]
7 processing at La Hague.

8 CHRIS WAHL: Great, ok, questions are still rolling
9 in.

10 This is outstanding.

11 Thank you for the audience.

12 By the way, this has been the most engaged audience
13 of our ten.

14 So hot topic, as they say, no pun intended.

15 Ok, here's another, here's another question.

16 Is there a concern about handling welded canisters
17 at San Onofre that have been gouged and are corroding as
18 they quickly approach their intended lifespan?

19 Will rolling stewardship be important to implement
20 to fill the gap until a permanent solution is available?

21 DOCTOR SVEN BADER: All right, so that's not
22 directly reprocessing related.

23 So that's actually about the canister itself.

24 Yeah, and I would defer to the experts on the
25 canister.

1 What I can say, yeah, we, we had that, yeah, we,
2 I've done a study personally on how to open up these
3 canisters.

4 So we have what's called a skiving device that
5 basically pulls out the root weld.

6 So this is something that we could implement at La
7 Hague if this decision is made to reprocess this fuel.

8 So we don't like welded canisters because, yeah, we
9 like to bring our fuel in dry, yeah, through, so we're
10 not putting stuff in the pool and getting contaminated.

11 And so we prefer bolted casks, but we understand in
12 the United States, almost everything's welded nowadays
13 because it's much cheaper than the bolted casks, which
14 are a lot thicker.

15 But yeah, the there's benefits to both sides.

16 Yeah, if, if there's concern about a canister and
17 there's no possible retrieval mechanism left at SONGS,
18 yeah, there there's a potential that we can take it at La
19 Hague and reprocess it.

20 But yeah, I'm not going to, yeah, make it sound
21 like it's an easy and cheap thing to do.

22 It's not cheap.

23 Transportation of spent fuel is not cheap,
24 especially when you got to go across the ocean.

25 So, yeah, but, but there are options.

1 Yeah, we're engineers.

2 We can solve these problems.

3 CHRIS WAHL: Right, right.

4 I, I learned once from a transportation expert that
5 there was nothing possible that couldn't be built.

6 It was just a matter of how much it was actually
7 going to cost, right?

8 That's very interesting to take it from that
9 perspective.

10 OK, here's a great question I think should be right
11 up your alley, which is what are the lessons learned from
12 a La Hague program that the United States could benefit
13 from or incorporate?

14 DOCTOR SVEN BADER: I think the main one is what I
15 said right out front is about Hanford.

16 They didn't do treatment of the waste.

17 Actually, if you look at part 50, CFR 50, it
18 requires you to deal with the waste.

19 That there's a lesson learned, that went right into
20 the regulation.

21 If we, if we want a commercial plant in the United
22 States, we're going to have to treat all the waste
23 before.

24 Yeah, you can, before you get a license to operate
25 the plant, you got to demonstrate that you can do that.

1 So, so at La Hague, we've got, you know, multiple
2 waste treatments.

3 You know, we, yeah, at one point we had three lines
4 out there.

5 We only have two lines now.

6 And so, yeah, some units are dedicated to each
7 line, some are dedicated to the waste that's coming off
8 both lines.

9 So it's yeah, they're, the waste treatment is is
10 huge.

11 Planning for decommissioning is another important
12 lesson learned.

13 You can see West Valley, I mean, this, the plant
14 hasn't been operational I think since the 70s and we're
15 still sitting there tearing it apart.

16 So yes, some of the lessons learned there are you
17 want to put in drip trays at the boiler vessels so that
18 if you do have a small leak, it doesn't contaminate
19 concrete because concrete is a is a pain to to have to
20 spall off and and then, then, then segregate between
21 what's clean and what's dirty when you throw it away is a
22 waste.

23 And so, so there, there's definitely a lot of
24 lessons learned.

25 We're learning lessons as we go as well at our

1 plant.

2 Yeah, I'm not going to reveal them all.

3 I don't know them all myself.

4 Yeah, we can go along along with that kind of long
5 discussion on decommissioning.

6 CHRIS WAHL: I think you also touched on this, but
7 maybe if you could provide just a little bit more
8 information on the current status of the Cigéo project,
9 timing, etcetera, if they're, if that exists.

10 DOCTOR SVEN BADER: Yeah, yeah, so I mean, Cigéo is,
11 is is active.

12 Yeah, we actually have a presentation coming up in
13 Washington by Andra themselves to give us an update what
14 they, where they're at.

15 But ultimately they are, you know, they've
16 submitted their license application, sorry, construction
17 application to the ANS.

18 Yeah, not American Nuclear Society, but the
19 security to nuclear security, which is the NRC equivalent
20 in France.

21 So they're reviewing that process.

22 It's multiple years, takes.

23 In France, you work by decrees in the nuclear
24 sector primarily.

25 So, yeah, so the regulator might approve it, but

1 now I need to get the equivalent of a Congress to approve
2 the decree to actually allow the next step of operations
3 go on.

4 On my question slide that I'd shown, there was a,
5 a, a picture of of what their timeline was and what
6 they're planning on doing, so, yeah.

7 CHRIS WAHL: Would you mind pulling that up again?

8 Yeah, just really quickly on the schedule or just I
9 think the readers, the viewers want to hear a little bit
10 more about that.

11 DOCTOR SVEN BADER: Sure, let's see here.

12 Let me, I don't know if it gets, and I'm looking at
13 this and I I see it doesn't go beyond what what the
14 current date was at the time of the slides.

15 Yeah, but there's an updated slide, updated picture
16 on this, on their website that shows, shows this S curve
17 here.

18 Let's see if you can see my mouse.

19 CHRIS WAHL: Maybe if we could put that in the chat,
20 the link to that, if we can find it quickly, that'll be
21 great.

22 DOCTOR SVEN BADER: Yeah, yeah, it's, I think it's
23 just at andra.fr and it shows you all the steps that
24 they're going through to, to get to the point where they
25 can start the actual construction.

1 They've got the main, the important points here is,
2 you know, one, they start in 1991.

3 So yeah, we started similar timeline on the U.S.

4 There now though, they've got an underground
5 research laboratory, which is a a critical element of
6 moving forward with repository justifying it.

7 So yeah, so I, I always pitch those.

8 I know there's several other countries that have
9 underground research labs, URLs.

10 Those, those are very important and probably a good
11 instrumental step on moving forward with the repository
12 program, regardless of where it's going to be in the
13 country.

14 So, yeah, the other parts of this, yeah, that
15 course level, yeah, it's on this slide and it shows you
16 the industrial operations planned somewhere between 2035
17 and 2040.

18 I believe the last time I heard a date in the
19 United States, we were looking at 2060, yeah, once the
20 site gets selected.

21 And then yeah, people say what's this active
22 authorization, final closure?

23 So you have pre-closure activities, which is when
24 you start actually filling up these repositories, and
25 then you have post-closure activities, which are all

1 basically passive.

2 And so at 2150 they'll seal the tubes, lock this
3 thing up and and just have warnings say, hey, don't dig
4 here type activities that we've had for WIPP and for
5 other repositories.

6 CHRIS WAHL: So, so we only have time for a couple
7 more questions, but I thought this was a really great
8 one.

9 And it says knowing as much as, you know, Doctor
10 Bader, if you could design the ideal fuel cycle program
11 today from a blank slate, what does it look like at a
12 national level in the United States?

13 DOCTOR SVEN BADER: Wow.

14 CHRIS WAHL: I told you it was a good question.

15 DOCTOR SVEN BADER: Yeah, that, I mean, it is a
16 great question and one that I wouldn't want to answer
17 unless I actually started doing some modelling, life
18 cycle modelling.

19 I I think the important point, yeah, is, is there
20 are multiple options.

21 There are lots of options out there.

22 And France, we're not done, yeah, we can't close
23 our fuel cycle with our our current PWR fleet.

24 So we will eventually have to have another fleet of
25 advanced reactors.

1 What those will exactly be, it depends on what we
2 want to do with it.

3 Yeah, yeah, and, and it depends what you want to,
4 how you want to continue the reprocessing.

5 Yeah, there's a yeah, there's another slide at the
6 end of the deck and my backup slides that shows you what
7 is a really ideal situation for the Dutch reactor where
8 basically we're going to reprocess all their fuel.

9 And when they shut that reactor down, the only
10 thing they're going to have at their side is a high level
11 waste canisters and their intermediate level waste
12 canisters in a building.

13 And that footprint of that building for that is
14 about a third of an SFC size in the United States.

15 So yeah, significant reduction in the footprint and
16 the building's got E equals MC squared printed on it.

17 And as it ages it starts fading just and that's the
18 the heat is dissipating as well as all this fission
19 products decay down.

20 So, ideal, yeah, I, I what I'll do is I'll point to
21 the the fuel cycle option study that Idaho did about, I
22 don't know, 10 years ago now, it's starting to feel old.

23 But yeah, in there they, we did a a really genuine
24 assessment of what it would take to move forward and
25 yeah, I think we ended up with a fast well, I know we had

1 a fast reactor that just helps you, yeah, transmute
2 things a lot better in respect to physical isotopes that
3 are getting burned up as you go.

4 The more times you recycle, the worse the fizzle
5 material is, the buildup of your absorbers are.

6 CHRIS WAHL: So I have I have one more question for
7 you and then I'm going to let you finish with some
8 closing comments if you'd like as well.

9 And the question is another hypothetical question,
10 but it's interesting, so and there's been a lot of
11 discussion about this as being the solution, right.

12 So if if you take cost out of the equation, which I
13 know you can't, but if you were to take cost out of the
14 equation, how long might you estimate it would take to
15 develop a reprocessing capacity in the United States to
16 reprocess all the spent fuel and what percentage of spent
17 fuel would have to be geologically disposed of?

18 DOCTOR SVEN BADER: Ok, lot, lot of caveats there.

19 Yeah, yeah, yeah, so we could recycle all the spent
20 fuel in this country.

21 Do we want to?

22 We have so much of it, it'll take a long time,
23 especially if we're only doing it at 800 metric tons per
24 year.

25 If I take cost out of it, yeah, then maybe I build

1 a big *** plant, sorry, a large plant and, and yeah,
2 3,200 metric tons or something like that, and, and, and
3 process it.

4 But even then it's going to take decades to get
5 through the the stockpile that we have in the United
6 States.

7 And I got like I said, I want to recycle it, so I
8 kind of put this back in a reactor, and that's the key,
9 yeah.

10 Do I put in a fast reactor to burn things down, or
11 do I put in another thermal reactor which will get me
12 another burn, but maybe not more than one or two, yeah.

13 And so there were a lot of caveats in there and I
14 forgot them already, but which is about..

15 CHRIS WAHL: Yes, basically how to reprocess it, if
16 we could reprocess everything without cost being a
17 factor.

18 DOCTOR SVEN BADER: Yeah, and so, I'll, let me just
19 point out what they did in the U.K.

20 So yeah, the U.K. was was reprocessed.

21 They're making them some fuels, MOX fuels, mostly
22 for overseas plants.

23 Then they kept recycling and now they have a large
24 pile of separated plutonium.

25 It's the largest in the world.

1 And people have looked at that as, oh God, this is
2 just a nightmare, but think about that.

3 If I had all that fuel, fuel still intact, all that
4 plutonium would be in 20-30 different spots.

5 Now it's in one spot that I know I got to have
6 safeguards for.

7 And then, yeah, a group came along and says, ok,
8 I've got an ideal plant that'll burn that up.

9 It's they did an assessment, said, oh, it's going
10 to take 1,000 years to burn all this plutonium.

11 And they said, oh, it's easier to throw away.

12 1,000 years of power, let's look at it that way.

13 Don't look at it as a waste.

14 Yeah, yeah, yeah, it's, it's difficult to tell
15 what's the right number, but if you do reprocess, yeah,
16 look for a place to to utilize that material and, and,
17 and be aware that this is a, this is a fuel supply for a
18 lot of different size reactors.

19 CHRIS WAHL: That's great and we have another minute
20 or two before we have to sign off.

21 I want to thank everybody.

22 This has been a very dynamic discussion.

23 We did not, unfortunately, unfortunately, we did
24 not get to every question.

25 So what we will do is we will take the questions we

1 haven't done, Jessica and I will answer those and make
2 sure they get recirculated to all the participants and
3 also post on our website.

4 Doctor, thank you so much for all of your
5 information today.

6 Are there any final thoughts that you'd like to
7 share before we sign off?

8 DOCTOR SVEN BADER: I see we're at 3:00 my time,
9 which I know is the top of the hour, so no, I, I just,
10 yeah, welcome anyone who wants to have a discussion about
11 this.

12 Yeah, I tried to be rational, you know.

13 I think, yeah, we are successfully doing in Europe
14 what we what we like to do.

15 But yeah, there are countries that don't like the
16 processes that we're doing so I understand that and I'll
17 try to tell you why we continue doing like we are.

18 CHRIS WAHL: Are you comfortable with us sharing
19 your contact information via e-mail or some folks some
20 way we can make or we can talk about it offline?

21 I know that there were people that had a lot of
22 questions and perhaps we can have a conversation offline
23 about how best to continue the dialogue if people have
24 it.

25 So Jess, let's make sure we do that as well.

1 I don't want to offer up your e-mail address to the
2 world, but we could at least be able to have some
3 dialogue.

4 And thank you again for your your participation in
5 our tenth webinar.

6 This was a very dynamic and full, full discussion,
7 fulsome discussion.

8 So thank you again and have a wonderful day.

9 DOCTOR SVEN BADER: Yeah, thanks for the questions.

10 CHRIS WAHL: Thank you for every, to everyone
11 participating, had a great crowd today, and we will see
12 you for our eleventh one soon.

13 Thank you so much.

14 DOCTOR SVEN BADER: Bye.