

PREDEC 2016: February 16-18, Lyon, France

# Preparation for Future Defuelling and Decommissioning Works on EDF Energy's UK Fleet of Advanced Gas Cooled Reactors

**John BRYERS, Simon ASHMEAD**

EDF Energy Generation Barnett Way, Barnwood, Gloucestershire,

Keywords : decommissioning, defuelling, waste management, transition, preparation, strategy

EDF Energy/Nuclear Generation is the owner and operator of 14 Advanced Gas cooled Reactors (AGR) and one Pressurised Water Reactor (PWR), on 8 nuclear stations in the UK.

EDF Energy/Nuclear Generation is responsible for all the activities associated with the end of life of its nuclear installations: defuelling, decommissioning and waste management.

As the first AGR is forecast to cease generation within 10 years, EDF Energy has started planning for the decommissioning.

This paper covers:

- broad outline of the technical strategy and arrangements for future defuelling and decommissioning works on the UK AGR fleet,
- high level strategic drivers and alignment with wider UK nuclear policy,
- overall programme of preparation and initial works,
- technical approaches to be adopted during decommissioning.

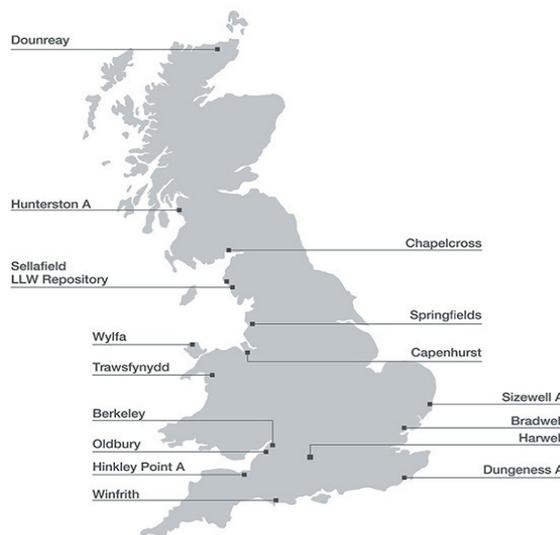


# The Decommissioning & Deconstruction (D&D) Context in the UK

Figure 1: EDFE UK



Figure 2: UK (NDA Estate)



- 7 AGR stations and 1 Pressurised Water Reactor (PWR) all operating
- D+D is funded by NLF backed by UK Gov.
- EDF Energy responsible for D+D though the government has an option to take ownership of stations
- Strategy in UK is Safestore for the graphite reactors (but prompt site clearance for Sizewell B PWR power station ).

Magnox fleet has 11 stations, 10 of which are in D+D. Owned by NDA. Also follows safestore strategy

8 of 11 Magnox stations have been defuelled to date with an average Defuelling time of 6 years

No stations are yet into their care and maintenance period (safestore) but two are planned to be by end 2016. The rest will not be in care and maintenance until the 2020's

Magnox uses the Parent Body Organisation (PBO) model Cavendish Fluor directing the works.

The Sellafield site houses the UK spent fuel management facilities

EDF Energy has Legal and moral responsibility for decommissioning and discharging the associated nuclear liabilities continues to rest with EDF Energy NG.

UK legislation relating to the decommissioning of nuclear power plants requires that "...all nuclear operators draw up strategies for decommissioning their redundant plant..." In response to this requirement, EDF Energy have formulated a corporate decommissioning strategy, corporate decommissioning plan and site-specific baseline decommissioning plans. EDF Energy, NG is committed to returning the existing power station sites to a state suitable for alternative unrestricted uses and delicensed.

EDF Energy, NG Power Station Decommissioning funding comes from Nuclear Liabilities Fund (NLF). The NLF is underpinned by Government- any shortfall met by Government (UK taxpayer).

# D&D Strategy - Key Phases

The Decommissioning process for an AGR site can be considered in three main phases of work:

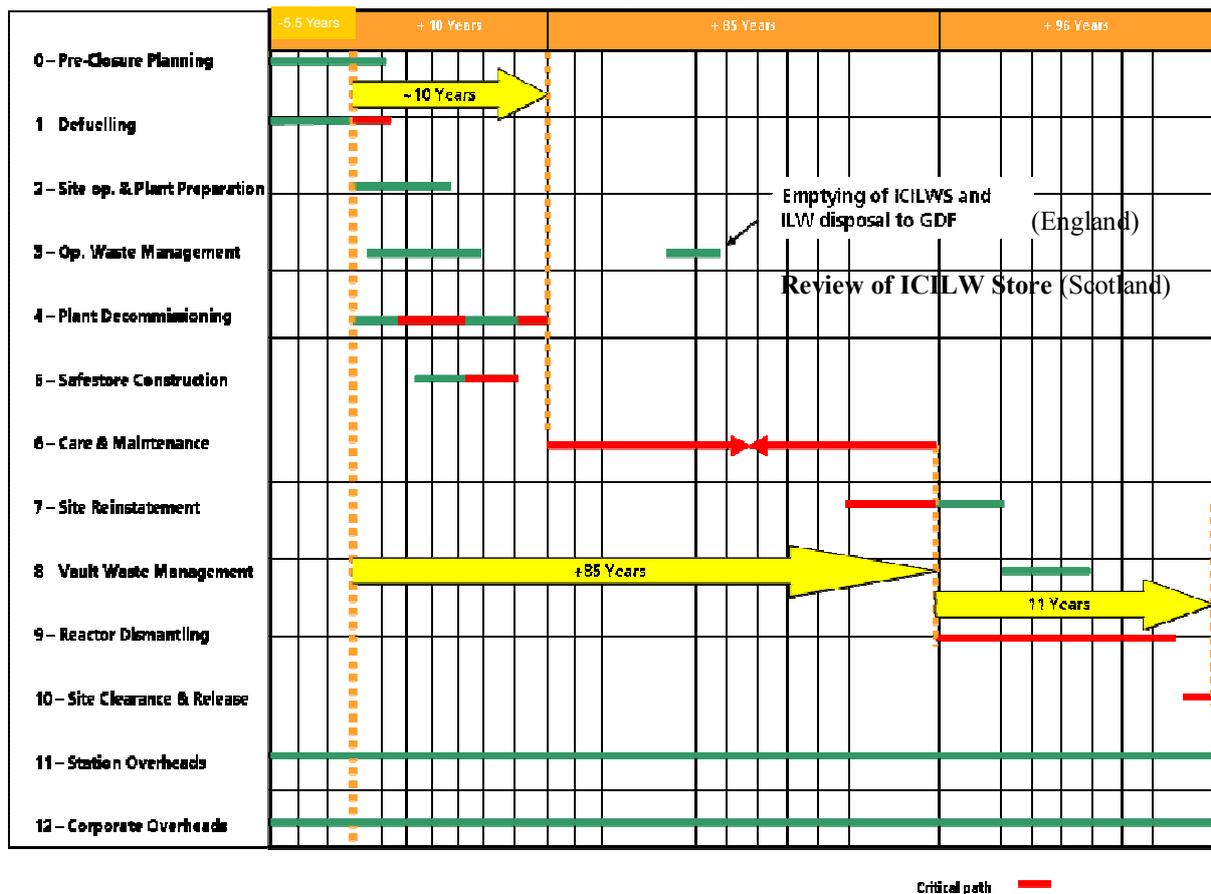
**Key Phase 1**—Pre Closure Transition, Defuelling and early decomm (commences circa 5.5 years before station closure),

**Key Phase 2**—Site Surveillance, Care & Maintenance (commences circa 10 ears after end of generation),

**Key Phase 3**—Reactor Building Decommissioning & Final Site Clearance (Commences circa 85 years after end of generation) dependant on disposal facility being available.

EDF Energy and its precursor organisations developed what became a decommissioning strategy with a common strand. This common strand involved some form of Safestore to allow a deferral of reactor dismantling, thus allowing for radioactive decay of the reactor structures and materials.

**Figure 3: Decommissioning Strategy Timeline (AGR)**



**Note:** PWR Prompt Decommissioning strategy similar to AGR – with no Safe Store period - decommissioning complete approximately 20 years after End of Generation.

## Decommissioning Strategy & Plan

The EDF Energy Strategy for the decommissioning of our AGR power stations is Early Safestore with Reactor Dismantling deferred for a period of 85 years after end of generation. Decommissioning of an AGR power station in accordance with this strategy involves the removal of all of the fuel and mobile radioactive wastes, and the dismantling and removal of all plant, equipment, services and buildings from the site outside of the two reactors and fuel stringer debris vaults. These residual structures are enclosed in a high integrity, secure Safestore structure and remain under surveillance, care and Maintenance for a period of 85 years after end of generation.

After this period, the vaults are emptied and the reactors and buildings dismantled. All Radioactive waste materials are processed and despatched from site to a suitable repository and the land returned to re-use.

The majority of the buildings and machinery on the site, such as the turbine hall, cooling water system, ancillary buildings, workshops, administration and welfare buildings are non-radioactive. They can be demolished using conventional techniques, and the majority of the materials re-used or recycled as far as possible.

Similarly, much of the plant and equipment within the reactor building is uncontaminated, and can again be removed using conventional techniques employing additional radiological precautions. Some plant and equipment is contaminated with radioactive material to a level which requires the use of special working practices & stringent radiological controls. In particular, the reactor building contains the two large nuclear reactors, which remain radioactive for a long time, and the fuel stringer debris vaults. These contain very highly irradiated materials, resulting initially in very high dose rates. A different approach must be used employing remote techniques to retrieve and process the wastes and to dismantle the reactors to ensure the safety of the workforce whilst protecting the public and the environment.

EDF Energy has adopted an 11 Activity approach to describe the decommissioning plan.

### The principal elements of the AGR Safestore decommissioning plan are:

Activity 0: Pre-Closure Preparatory Work

Activity 1: Defuelling

Activity 2: Site Operation and Plant Preparation

Activity 3: Management of Potentially Mobile Operational Wastes

Activity 4: Plant Decommissioning

Activity 5: Safestore Development

Activity 6: Site Surveillance, Care and Maintenance

Activity 7: Site Reinstatement

Activity 8: Retrieval & Management of Stored Active Waste

Activity 9: Reactor Dismantling and Reactor Building Dismantling and Clearance

Activity 10: Site Clearance and Release for Reuse.

In many cases the activities overlap significantly in time, and are not necessarily sequential. Activities 0 to 5, culminate in completion of the Safestore, and will be completed within about ten years of station closure. The stations will then progress to Activity 6, a period of surveillance, care and maintenance. Activities 8 to 10 will then be deferred for a period of 85 years after shutdown, and again take approximately 10 years to complete.

# Key Phase 1 - Pre closure Transition & Defuelling

**This Key Phase of the decommissioning of the site includes the following Decommissioning Activities:**

- **Activity 0 - Pre-Closure transition and Preparatory Work,**
- **Activity 1 - Defuelling,**
- **Activity 2 - Site Operation & Plant Preparation,**
- **Activity 3 - Management of Potentially Mobile Operational Wastes,**
- **Activity 4 - Plant Decommissioning.**

## **Pre-Closure Preparatory Work**

There is a wide and growing body of evidence that commencing preparation works for decommissioning at an appropriately early stage is key to reducing risks and controlling overall decommissioning costs. EDF Energy baseline is to start preparation works from circa T-5.5 years for any given station against planned closure dates. The period of preparation for D&D activities offers an opportunity to de risk these future activities. Industry learning suggests that starting these activities early is highly beneficial. In addition an early start to key activities de risks a non elective closure scenario.

Hence, circa 5.5 years before the planned closure date for a station, a programme of transition and preparatory work will be initiated to ensure that there is no delay to commencement of defuelling following end of generation and to ensure that the site is decommissioned safely, and as efficiently and economically as possible.

The tasks will include for example preparation of:

- a Defuelling Safety Case,
- a Detailed Decommissioning Plan
- a Near Term Work Plan (NTWP)
- an Article 37 Data Submission
- an Environmental Impact Assessment (EIA)
- a Planning Application
- Decommissioning Management Arrangements
- a Decommissioning Programme
- Revisions to the outage management programme
- Revisions to the Maintenance Schedule
- Revisions to Discharge and Disposal Authorisations
- Revisions to Site Safety Management Arrangement

In many cases approval of the submissions will be required prior to commencement of decommissioning on the site, which will require the preparation of the submissions in a timely manner to ensure approval is obtained in accordance with the planned programme for the power station.

## Defuelling

The first major activity following cessation of generation will be the defuelling of the reactors and the transfer of the spent fuel off site to Sellafield. Defuelling will proceed as soon as practicable following reactor shutdown, following receipt of approval of the defuelling safety case from the Office for Nuclear Regulations, the UK nuclear regulator and on completion of work to enhance the fuel route performance. The process will be undertaken using the existing fuel route equipment and will employ procedures based closely on existing operational procedures. Any new fuel that remains on the station at the time of shutdown will also be dispatched off site. To maximise the utilisation of fuel, it is assumed for planning purposes, that the first reactor will shutdown one year before the second, and that low burn-up fuel will be transferred from the first reactor to refuel the second reactor. This enables us to stop buying and loading new fuel into the second reactor and maximises the utilisation of the fuel already bought. In addition, this first reactor will be defuelled and the fuel despatched off site.

Defuelling of the reactors will be undertaken at an enhanced rate, and the fuel will be transferred off site to Sellafield at a rate approximating to the rate at which it is removed from the reactors. It is expected that all fuel will be despatched from site over a period of circa 3.5 years following shutdown of the first reactor. This activity represents the removal of 99.9% of the radioactive inventory from the power station, resulting in a major

## Site Operation & Plant Preparation

As defuelling, waste management and other decommissioning work proceeds, various systems are required to remain operational to maintain the safe operation of the plant. These systems will continue to be operated by our own experienced staff employing the same or very similar procedures to those utilised during the operational life of the plant. Following final shutdown of the reactors, plant, systems and electrical equipment which are not required for safety reasons, will become progressively redundant. Redundant electrical systems will be isolated and made safe. Redundant mechanical plant and systems will be taken out of service and isolated, drained and purged or flushed and vented to make them safe, and potentially hazardous materials will be removed off site as soon as is reasonably practicable. In some cases this action may be necessary in support of the nuclear safety case (e.g. isolation of control rod systems for the defuelling safety case), while in others a net industrial safety benefit is achieved without any detriment to nuclear safety (e.g. removal of redundant chemicals & turbine oil systems).

To facilitate decommissioning, and the removal of some of the services, new alternative services need to be installed. These include, for example, a new site electrical supply and distribution system and alternative liquid effluent discharge arrangements. These enable the decommissioning of the existing high voltage electrical systems and of the cooling water system at the appropriate time. This Activity commences with the closure of the reactors and extends over most of the period prior to Safestore construction as plant and equipment becomes redundant.

## Management of Potentially Mobile Operational Wastes

Operation of the power station will have resulted in the production of radioactive wastes as solids, liquids and gasses, and these can fall into the categories of Low Level Waste (LLW) or Intermediate Level Waste (ILW). Gaseous effluent will have been processed as it arose utilising the best practicable means available to reduce the radioactivity to acceptable levels, then discharged within the limits set by the legally binding discharge authorisations. The processes give rise to filters, gas drier desiccant and carbon adsorption media which capture and concentrate the radioactivity. Where these are categorised as LLW, they are processed and disposed of during the operational life of the power station, with the residual LLW being sent to the national LLW disposal site.

Liquid radioactive effluent is similarly treated using the best practicable means available, and the resulting liquor is then discharged within the legally binding discharge authorisations. The particulate and radioactivity from the liquid is captured and concentrated on filter media and/or on ion exchange resins. The sludges and resins are accumulated in storage tanks during the operation of the site for final processing after end of generation. Operation of the power station also gives rise to solid wastes. Application of the waste hierarchy such as minimisation and segregation, and the use of a range of waste recycling and disposal routes, are employed to maximise the life of the LLW national disposal facilities. A small volume of ILW solid waste also arises during operation. This is placed in storage for treatment during decommissioning. LLW sludges and ion exchange resins will be retrieved from their accumulation tanks for processing at the earliest practicable opportunity after end of generation. They will be encapsulated in cement based grout in 200 litre mild steel drums. These will then be transferred to the LLW disposal facility. As the radioactive dose rates from these wastes is low, a simple Mobile LLW Encapsulation Plant is utilised for their processing. A small number of campaigns to process LLW sludge have already been undertaken at our power stations.

ILW sludges and ion-exchange resins will similarly be retrieved from their accumulation tanks for processing at the earliest practicable opportunity after End of generation. They will be encapsulated in cement based grout in robust 500 litre stainless steel drums in preparation for their off-site disposal when a suitable ILW repository is available. Until this time, they will be stored on site in a newly constructed Interim Conditioned Intermediate Level Waste Store. In this instance however the radioactive dose rate is such that remote retrieval and processing of these materials is necessary, resulting in a more complex plant.

The retrieval and processing of these wastes represents a further significant reduction in the residual hazard on the site and an increase in passive safety.

The cleanup and decontamination of the radioactively contaminated plant during the early phases of decommissioning will give rise to similar wastes to those described above. These will be managed in exactly the same way.

A LLW disposal site is currently available for the disposal of operational and decommissioning LLW within the constraints of its acceptance criteria and is expected to remain operational until at least 2050. It is the UK Government intent that a National Repository for ILW will be constructed, although it is presently not expected to be available before 2040. In Scotland the Higher Active Waste (HAW) policy is applicable for Hunterston B and Torness power stations. All waste not suitable for disposal as LLW will remain on site pending the availability of a near surface, near site storage and disposal facility.

The preparatory work to obtain the necessary regulatory approvals for these tasks and to get the planning consent for the construction of the facilities means that the work has to commence prior to end of generation so that waste retrieval and processing can commence in a timely manner. Waste retrieval and processing tasks commence less than a year after end of generation, and complete about 8 years later. The programme duration also includes the interim storage of the packaged ILW and its subsequent retrieval from the store, which is currently planned to commence in circa 2040 for sites in England.

## Plant Decommissioning

The scope of work in this decommissioning activity includes the decommissioning of all plant, equipment, facilities and buildings on the site outside of the reactors and the fuel stringer debris vaults. All non-radioactive plant and buildings, such as the turbine hall, circulating water system, and ancillary buildings, will be dismantled allowing plant and materials to be recycled where possible and reducing the visual impact of the site. Radioactive plant and systems within and outside of the reactor building will also be removed. This includes facilities such as the cooling ponds, fuel transfer system, flask handling plant and active waste treatment systems.

Off shore structures will be demolished to sea bed level, and all onshore tunnels and culverts will be backfilled to prevent collapse at a later date. Basement areas and tunnels will be backfilled and regraded to restore the levels. Inert non-radioactive waste materials will be retained on site and will be used for the infilling of these basements. At this stage however there remains a significant deficit of fill material for the basement areas which will have to be imported onto the site. Care will be taken to segregate wastes for further management, and avoid any contamination of the ground. Most of this work will be undertaken by specialist decommissioning and demolition contractors.

## Decommissioning Waste Management

A Decommissioning Waste Processing Facility (DWPF) will be constructed to process all wastes which are potentially radioactive. This facility will process and package all wastes into appropriate containers for subsequent reuse or recycling, disposal or long-term storage. Decontamination processes and volume reduction techniques will be employed where appropriate to reduce the volume of radioactive waste to be disposed.

The majority of waste generated from this phase of decommissioning is either non active or LLW. The small fraction of ILW produced will be treated, packaged and stored on site in the Interim Conditioned waste store until disposal facilities are available.

LLW will be sent off site for disposal using appropriate routes, including the LLW disposal site and non active waste will either be reused on site or sent to landfill. Non-radioactive material will be recycled (metals), used for landfill (rubble) or be disposed of at appropriate waste disposal sites (e.g. asbestos). Such disposal sites are presently available and are expected to remain available on the required timescales.

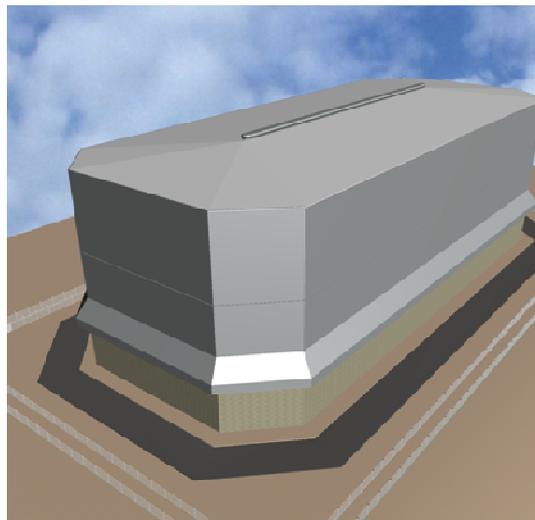
## Safestore Construction

To take advantage of the natural reduction in radioactivity with time, we plan to defer the dismantling of the reactors and vaults until 85 years after end of generation. To achieve this, having removed all of the other plant, equipment and buildings as described previously, the remaining structures will be placed in “safe-storage”. The objective of this approach is to place the residual radioactivity within the reactors and vaults in a secure passively safe condition which does not require short term intervention to maintain its safe containment.

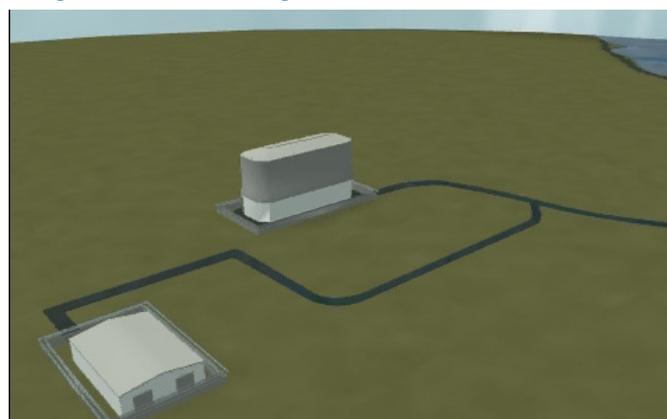
The radioactivity will then naturally reduce with the passage of time, reducing the hazard for the final decommissioning and making the job technically less challenging. The need for any operational systems within the safestore structures is minimal. Passive ventilation of the reactor and safestore structure will be employed, and measures will be taken to manage any internal drainage accumulations. The external fabric of the building will be upgraded to a suitable standard based on either the utilisation of the elements of the existing building structure, or on a new building to be constructed to envelop and protect the reactor and vault structures. The primary function of the safestore structures and their contents will be to remain safe, contained, weatherproof and secure for the deferral period whilst requiring very low levels of care and maintenance. The Safestore building is designed to be both robust, to withstand the most adverse weather conditions, and secure against intrusion. The condition of the facility is continuously monitored with all plant alarms and indications, and security equipment monitored 24 hours per day, 365 days per year.

Employing these measures will achieve the aim of providing stable storage conditions of passive safety where no active operator intervention on a short-term basis is required. The height of the building will be reduced by about 25%, which along with the removal of the other operational buildings, will considerably reduce the long term visual impact of the site. On achieving the safestored condition, we could release part of the site and make it available for re-use for another power station or for an alternative purpose if required.

**Figure 4: Safestore Structure**



**Figure 5: Site during C&M—with ILW store**



## Key Phase 2 - Site Surveillance, Care & Maintenance Period

This phase lasts from circa 10 years after e.o.g. to approx. 85 years after e.o.g

**This Key Phase of the decommissioning of the site includes the following Decommissioning Activities:**

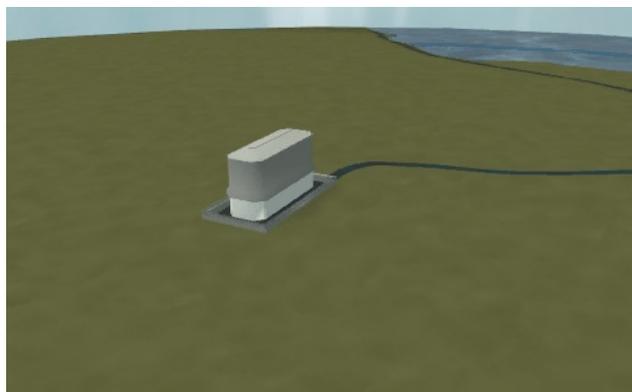
- **Site Surveillance, Care & Maintenance - Activity 6.**

### Site Surveillance, Care & Maintenance - Activity 6

The design basis of the safestore structure is that it requires only a minimal programme of work to sustain the safe, stable, passive storage conditions and the continued integrity of the safestored reactors and site. Remote monitoring and surveillance systems, along with the intruder resistant design of the safestored structures, ensure that the security of the site is maintained during the C&M period. There will be periodic visits by a centrally based team to inspect and monitor the site and its environs. This includes visual inspections programmes of the site, reactor and Safestore, radiological and environmental monitoring, general grounds maintenance and any other activities required. On a very infrequent basis during the surveillance period there may be a need for more substantial refurbishment or replacement of materials, e.g. of building cladding materials or supports. It is not intended that there be frequent access inside the Safestore structures as the expected storage conditions will not require it. However, there will be a programme of access into the Safestore to inspect and monitor the internals to substantiate the continuing acceptability of the storage conditions, the integrity of the structures and the containment of radioactivity. Additionally, access will be made on a periodic basis for routine inspection.

The selection of highly durable materials, careful design of details, and high quality construction for the Safestore supports the infrequent need for maintenance of the facility. During the C&M period for sites in England, it is expected that a national ILW repository will become available, that the conditioned and packaged waste will be transferred from the Interim Conditioned ILW Store, and that the store will be decommissioned and dismantled. It is currently assumed that the repository will be available to take these stored waste in 2040. The surveillance period will commence about 10 years after end of generation, with the site remaining in this passive condition for about 75 years under a regime of continuous monitoring and surveillance, and subject to periodic care and maintenance. A programme of radiological and environmental monitoring of the reactor and Safestore internals, and of the area surrounding the site will be carried out to ensure that conditions are as expected, and that there are no unexpected radiological releases to the environment.

**Figure 6: Site following removal of ILW Store—Disposals to GDF CIRCA 2040**



## Site Reinstatement - Activity 7

In the last few years of the Care and Maintenance period the site will be re-established as a major “engineering project site” requiring a programme of preparatory work and construction of new facilities in readiness for the final decommissioning and waste retrieval activities.

During this period we will also carry out final decommissioning planning, to ensure that all regulatory requirements are met and that robust plans are in place for reactor dismantling and final site clearance.

Some of this work will include the preparation and approval by the appropriate regulator of a number of regulatory submissions including, for example:

- Detailed designs for dismantling facilities and equipment.
- An Environmental Statement
- Planning approval for new facilities

Should a suitable repository or disposal facility for the radioactive waste arising from the subsequent tasks not be available, it is likely that this activity and the subsequent activities will be delayed, subject to the maintenance of the safety case for the safestored facility. In these circumstances, these activities will be deferred until such a time that a suitable repository is available to receive the radioactive wastes from the vaults and the reactor dismantling tasks.

- Detailed decommissioning programme
- Safety cases
- Any necessary revisions to discharge authorisations and Article 37 data

Other activities will include construction and engineering works to prepare for the final dismantling tasks. This will include

- Provision of the necessary infrastructure, services such as water, electricity, telecommunications, IT etc
- Construction of site engineering and welfare facilities for staff and contractors engaged in reactor dismantling and final site clearance.
- Construction and commissioning of a Waste Management Centre (WMC) for the processing of reactor and debris vault wastes.
- Construction of a control centre for the control and oversight of all activities on the site.
- Establishment of a contractors compound and an area for stockpiling of “clean” scrap material for recycling, and of inert building material to be used for basement infill.

## Key Phase 3 - Reactor Building Decommissioning & Final Site Clearance

**The final Key Phase of the decommissioning process for an AGR site can be considered as three main tasks:**

- **Retrieval & Management of Stored Active Waste - Activity 8,**
- **Reactor Dismantling and Reactor Building Dismantling and Clearance - Activity 9,**
- **Site Clearance and Release for Re-use. - Activity 10.**

During the final phase of decommissioning, following initial works undertaken as part of the reactor dismantling task, the retrieval of stored wastes from the vaults and dismantling of the reactors proceed very much as parallel activities. They are however separate tasks, and for simplicity they are described separately here.

## Retrieval & Management of Stored Active Waste - Activity 8

During operation of the station, as part of normal fuel route operational procedures, activated and contaminated components will have been placed into debris vaults as an interim storage measure. These components include for example, parts of the fuel assemblies which cannot be reused and redundant control rods. These are largely made from chemically inert materials such as stainless steel and graphite, which have become radioactive by virtue of their operation within the reactor. These materials are retained within very substantial concrete vaults during the Site Surveillance period in order to take advantage of the reduction in radioactivity with time.

These activated and contaminated components are retrieved from the vaults during this phase of decommissioning. Suitable access will be formed into the vaults to enable the deployment of remotely operated equipment to retrieve the radioactive materials. These wastes will be transferred to the Waste Management Centre in sealed, shielded containers, where they will be sorted and sampled as necessary for inventory purposes, then packaged and disposed to a suitable waste repository. It is assumed that such a repository will be available at this time, so that minimal on-site buffer storage for the packages is required. ILW will be packaged in standard Nirex 4 meter boxes for disposal at a suitable repository/disposal facility. LLW will be packaged in a standard half height ISO container, for disposal at a near surface repository.

## Reactor Dismantling and Reactor Building Dismantling and Clearance - Activity 9

Final dismantling and radiological clearance of the AGR sites will occur after the surveillance period and completion of site re-establishment, nominally commencing 85 years after End of Generation for planning purposes. The timescale for the start of the final dismantling work is not fixed and it would be technically feasible to undertake it on an earlier or later timescale if that was deemed necessary or was judged to be the optimum approach. The main task during this Activity is the dismantling of the reactors and Safestore and the transfer of the resultant radioactive waste materials to the Waste Management Centre. Here, the waste will be sorted, and sampled as necessary for inventory purposes. Radioactive wastes will then be packaged and disposed to a suitable repository (assumed to be available, so wastes can be disposed of as they arise). The milestones are:

- Site re-establishment is completed and decommissioning tasks can commence
- Reactor and Safestore dismantling is completed leaving the Waste Management Centre, other buildings and infrastructure.
- All site buildings and infrastructure is removed leaving the site ready for final clearance and landscaping.

While this task is carried out by machine, the dose rates are very low permitting manual intervention and support as necessary. Having gained entry to the reactor core, the steel standpipes and top dome above the reactor core are removed. Dose rates here are relatively low, so a significant amount of manual work can be undertaken in conjunction with remotely operated equipment to dismantle components in this very congested area. Boiler dismantling can progress at the periphery of the reactor core using substantially manual methods because dose rates here are very low and access for remotely operated equipment is difficult. A shielded containment is constructed over the reactor pilecap area, leading to the waste route and the Waste Management Centre (WMC). This containment, supports a high integrity crane, and houses the equipment for remotely dismantling the reactor core, and for packing the waste into transit containers for transfer to the WMC. A secondary containment is extended above the Safestore roof to form a secondary containment, housing ventilation equipment, remote viewing & lighting equipment, and facilities for the maintenance of the reactor dismantling equipment.

## Site Clearance and Release for Re-use Activity 10

The end point of decommissioning a power station will be the eventual and complete clearance and de-licensing of the site. Following final dismantling, an environmental monitoring programme will be undertaken to check for the presence of any residual radiological or chemical hazard on the site. Where necessary any contaminated land will be treated to remove the hazardous material and the site will be landscaped sympathetically with its surroundings. On completion the site will be clearance monitored to check that all radioactive materials of regulatory concern have been removed from the site, and the site subsequently delicensed and made available for reuse.

## Conclusions

EDFE energy are actively preparing for end of generation as this supports the transition to effective and efficient defuelling and decommissioning.

EDF Energy has a well developed prudent and approved basis for AGR decommissioning.

Work has commenced to ensure the seamless transition from operation to defuelling for EDF Energy AGR sites.

Opportunities exist for further optimisation of the decommissioning strategy and plan, with associated business opportunities, these are being actively considered.

A range of factors are taken into account when determining the most appropriate decommissioning strategy.

The current AGR Strategy of Early Safestore (with deferred reactor dismantling) and PWR (Sizewell B) strategy of Prompt Decommissioning (with reactor dismantling commencing within 10 years of end of generation) are both robust, underpinned and approved.

There are benefits of an AGR Early Safestore strategy with reactor dismantling deferred for a period of 85 years after end-of-generation;

- Allows for a significant period of radioactive decay,
- Reduces radiation exposure levels for workers- ALARP,
- Provides a significant reduction in radioactive waste quantities, greater volumes of inactive material available for recycle and re-use,
- Allows for simpler dismantling methods, less reliance on remote operations,
- Allows significant NPV cost benefit from deferral,
- Aligns with the availability of permanent waste disposal facilities (GDF).

Early Safestore is considered the most appropriate decommissioning strategy for EDF Energy, NG AGR stations taking account of all relevant factors (note that this is a similar approach to that being taken forward for UK Magnox stations).

DF Energy decommissioning strategy will continue to be kept under review taking account of updated information, including any changes to relevant government policy / legislation. The first AGR planned closure will occur around 2023 and the whole AGR fleet will be closed by circa 2030.

The first planned station closure dates are now within 10 years.

Circa 6 years pre closure preparation is required to ensure that a smooth transition to defuelling and deconstruction occurs and costs are minimised during this period.

Under the current legal obligations agreed between EDF Energy and UK Government, EDF Energy is responsible for the defuelling and deconstruction of the nuclear fleet once generation ceases.

Funding for this work is provisioned within the Nuclear Liabilities Fund.