

Generic design assessment

UK EPR™ nuclear power plant design by AREVA NP SAS and Electricité de France SA

Final assessment report

Generic site



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Final assessment report:

Generic site characteristics

Protective status

This document contains no sensitive nuclear information or commercially confidential information.

Process and Information Document¹

The following sections of Table 1 in our Process and Information document are relevant to this assessment:

Section 1.3:

We require the Generic Site Characteristics that the requesting party wishes us to take into account when assessing the environmental impact of the reactor design. If we issue any statement of acceptability after our assessment it would be on the basis of these characteristics. A range of generic sites might be addressed with coastal, estuarine and inland characteristics.

Radioactive Substances Regulation Environmental Principles²

The following principles are relevant to this assessment:

SEDP1 General RSR Principle for siting new facilities - When evaluating sites for a new facility, account shall be taken of the factors that might affect the protection of people and the environment from radiological hazards and the generation of radioactive waste.

Report author

Original – Tooley, E. J.
Reviewed and updated to final – Green, R.

1. Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs, Environment Agency, Jan 2007.

<http://publications.environment-agency.gov.uk/pdf/GEHO0107BLTN-e-e.pdf>

2. Regulatory Guidance Series, No RSR 1: Radioactive Substances Regulation - Environmental Principles (REPs), 2010.

<http://publications.environment-agency.gov.uk/pdf/GEHO0709BQSB-e-e.pdf>

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Summary

- 1 In order to demonstrate that discharges and other environmental impacts from the reactor designs would be consistent with UK dose constraints and limits and other UK environmental constraints and limits and hence be amenable to authorisation, we require a typical UK (generic) site to be defined against which the impacts can be assessed.
- 2 We have carried out an assessment of EDF and AREVA's generic site characteristics.
- 3 We consider that the UK EPR™ generic site characteristics are justified and reasonable for the GDA stage and represent a conservative whilst retaining a sufficient amount of realism. We consider the parameters and their values which define the UK EPR generic site are appropriate for use in the assessment of radiological impact at the GDA stage. We recognise that detailed site specific assessments of the radiological impact from the UK EPR will be required at the site specific stage using data and information which relates to the site at which a UK EPR reactor may be located. This is dealt with in our Assessment Reports on the radiological impacts on members of the public (EAGDAR UK EPR-11, Environment Agency, 2011b) and non human species (EAGDAR UK EPR-12, Environment Agency, 2011c).
- 4 We conclude that EDF and AREVA's generic site parameters and their values which define their generic site are appropriate for use in their assessment of radiological impact at the GDA stage.
- 5 Our findings on the wider environmental impacts and waste management arrangements for the UK EPR reactor may be found in our [Decision Document \(Environment Agency, 2011a\)](#).

1 Introduction

6 We originally published this report in June 2010 to support our GDA consultation on the UK EPR design. The consultation was on our preliminary conclusions. It began on 28 June 2010 and closed on 18 October 2010.

7 We reviewed this report after considering relevant responses to our consultation. We did not receive any additional information from EDF and AREVA on this topic after their March 2010 update of their submission. Where any paragraph has been added or substantially revised it is in a blue font.

8 We do not specifically deal with all consultation responses in this report, they are covered in detail in the Decision Document (Environment Agency, 2011a). However, where a response prompted additional assessment by us this is referenced, the key to GDA reference numbers is in Annex 7 of the Decision Document. The conclusions in this report have been made after consideration of all relevant responses to our consultation.

9 In order to assess the potential impact of a particular reactor design on the environment we need to know the characteristics of the generic site proposed by EDF and AREVA. We recognise that at the generic design assessment stage the specific location of the nuclear plant is not known and therefore the impact assessment will be a scoping assessment which will be followed by a significantly more detailed site specific assessment once the locations of the plants and associated receptors are better known. However at the generic design assessment stage we need to satisfy ourselves that:

- a) the reactor design is such that any environmental impacts would be acceptable to the UK;
- b) any particular features of the reactor design which may lead to impacts of a type or magnitude which could constrain the locations at which such a plant could be located are identified; and
- c) any environmental impacts of new build reactors in the UK are as low as reasonable achievable (ALARA), in line with the policy set out in the Energy White Paper (BERR, 2008).

10 In order to demonstrate that discharges and other environmental impacts from the reactor designs would be consistent with UK dose constraints and limits and other UK environmental constraints and limits and hence be amenable to authorisation, we require a typical UK (generic) site to be defined against which the impacts can be assessed.

11 The types of parameters that may be included in the site descriptions are:

- a) Physical aspects of the location.
- b) Distance to nearest occupied buildings and centres of population.
- c) Habits of local population.
- d) Impacts on non-human biota.
- e) Local presence of designated or protected sites for example, Sites of Special Scientific Interest (SSSIs¹), Special Protection Areas (SPAs²) or Ramsar sites³.

¹ Site of Special Scientific Interest Identified / notified by English Nature or the Countryside Council for Wales under the Wildlife and Countryside Act 1981 for its importance to nature conservation

² Special Protection Areas. An area classified as such under the EC Birds Directive to provide protection to birds, their nests, eggs and habitats: areas that are internationally important sites designated under the EEC Wild Birds Directive.

- f) Physical parameters such as meteorological dispersion parameters, liquid discharge parameter, atmospheric discharge parameters and abstraction parameters.
- 12 EDF and AREVA have derived their UK EPR generic site characteristics assuming the UK EPR will be located at a coastal site. The generic site characteristics have been chosen to provide a good geographic representation and represent typical data for sites where potentially a new UK EPR reactor might be located.
- 13 During the assessment certain matters were identified and dealt with using the Regulatory Observation and Technical Query system.

2 Assessment

- 14 This assessment considers the generic site described by EDF and AREVA which has been used in the assessment of the potential impact of a UK EPR on members of the public and non-human species. We have taken into account Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment (DECC, 2009) which sets out the principal that:
- a) regulatory justification of practices should be carried out by the Government;
 - b) optimisation of protection on the basis that radiological doses and risks to workers and members of the public from a source of exposure should be kept as low as reasonably achievable (the ALARA principle);
 - c) application of limits and conditions to control discharges from justified activities;
 - d) sustainable development;
 - e) the use of Best Available Techniques (BAT);
 - f) the precautionary principle;
 - g) the polluter pays principle;
 - h) the preferred use of 'concentrate and contain' in the management of radioactive waste over 'dilute and disperse' in cases where there would be a definite benefit in reducing environmental pollution, provided that BAT is being applied and worker dose is taken into account.

2.1 Assessment methodology

- 15 The basis of our assessment was to:
- a) consider the submission made by EDF and AREVA in particular the Pre-Construction Environmental Report (PCER) and its supporting documents;
 - b) hold technical meetings with EDF and AREVA to clarify our understanding of the information presented and explain any concerns we had with that information;
 - c) raise Regulatory Observations and Technical Queries where we believed information provided by EDF and AREVA was insufficient;
 - d) assess the generic site characteristics proposed by EDF and AREVA and decide if they are reasonable;
 - e) [consider consultation responses and comments from our July 2010 stakeholder seminar relevant to this topic;](#)
 - f) [decide on any GDA Issues;](#)

³ A site of international conservation importance classified at the 'Convention on Wetlands of International Importance' 1971, ratified by the UK Government in 1976.

- g) [identify assessment findings to carry forward from GDA.](#)
- 16 EDF and AREVA provided their submission to GDA in August 2007. We carried out our initial assessment and concluded we needed additional information. We raised a Regulatory Issue on EDF and AREVA in February 2008 setting out the further information that we needed.
- 17 EDF and AREVA completely revised their submission during 2008 and provided a Pre-Construction Environmental Report (PCER) with supporting documents.
- 18 We assessed information contained in the Pre-Construction Environmental Report but found that while much improved from the original submission there were some areas where we required further information.
- 19 We raised 31 Technical Queries (TQs) on EDF and AREVA during our assessment. Three were relevant to this report (in part):
- Marine dispersion parameters for dose assessment.
 - Dose assessment assumptions – short-term releases.
 - Non-human species impact assessment.
- 20 EDF and AREVA responded to the TQs. They reviewed and updated the PCER in March 2010 to include all the relevant information provided by the TQs.
- 21 [The PCER was further updated in March 2011 to include information supplied by EDF and AREVA since March 2010. The main source for this report, PCER chapter 10 ‘Site environmental characteristics’ was revised with minor editorial changes, update of references, information on potential multiple reactor submissions and the Water Framework Directions 2010 and the publication of river basin management plans. This report only uses and refers to the information contained in the updated PCER and its supporting documents.](#)

2.2 Assessment objectives

- 22 Key areas of the submission made under the GDA arrangements by EDF and AREVA for the UK EPR design that have been considered are:
- Are the generic site characteristics reasonable and justified?
 - Are there any aspects of the generic site that would preclude any location at site specific permitting?

2.3 EDF and AREVA documentation

- 23 The Pre-Construction Environmental Report is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
UKEPR-0003-011	PCER-Sub-chapter 1.1 - Introduction	04
UKEPR-0003-012	PCER – Sub-chapter 1.2 – General description of the unit	02
UKEPR-0003-090	PCER – Chapter 9 – Principles and methods used for environmental approach at the design stage	02

Document reference	Title	Version number
UKEPR-0003-100	PCER – Chapter 10 – Site environmental characteristics	04
UKEPR-0003-110	PCER – Chapter 11 – Radiological impact assessment	02

24 We use short references in this report, for example:

- a) PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1;
- b) BAT Demonstration section 3.2 = EPRBs3.2.

2.4 Assessment

25 We have assessed the information on the generic site in the submission made by EDF and AREVA for its UK EPR design.

26 The information is included in the PCER Chapter 10 - Site environmental characteristics and Chapter 11 - Radiological Impact Assessment.

27 During the assessment certain matters were identified and dealt with using the Regulatory Observation and Technical Query system.

28 Technical Query TQ-EPR-186 required EDF and AREVA to justify certain marine dispersion parameters they had selected for their generic site and had used in their dose assessment, in particular volumetric flow rate used in individual and collective dose assessments. EDF and AREVA's response was taken into account by our contractor undertaking the validation and verification of EDF and AREVA's dose assessment. (see our dose assessment report IMAS/TR/2010/05, Environment Agency, 2010a).

29 Technical Query TQ-EPR-180 required EDF and AREVA to provide information on certain parameters they had selected for their generic site and had used in their short-term dose assessment. EDF and AREVA's response was taken into account by our contractor undertaking the validation and verification of EDF and AREVA's dose assessment.

30 Technical Query TQ-EPR-237 required EDF and AREVA to provide further information aspects of their assessment of impact on non-human species. Relating in particular to the generic site characteristics the Technical Query required EDF and AREVA to justify that the impact on the freshwater eco-system need not be considered. EDF and AREVA's response confirmed that a freshwater eco-system need not be considered at the generic stage but would be assessed at the site specific stage if appropriate.

31 EDF and AREVA assumed a coastal generic site with no freshwater eco-systems. The generic site characteristics were chosen by EDF and AREVA to provide a good geographic representation and represent typical data for sites where potentially a new EPR reactor might be located.

32 EDF and AREVA's UK EPR generic site characteristics include data on:

- a) **Exposed population groups** – for dose assessment purposes EDF and AREVA have considered five exposure groups:
 - i) Two locally resident farming families were assessed who had exposure pathways associated with atmospheric releases from the UK EPR. The first local resident farming family who live 500 m from the aerial discharge point. They spend most of their time at home, some of which is spent outdoors (50% indoors and 50% outdoors for adults). They eat terrestrial food from local sources (vegetables, milk and meat), which are 500 m from the aerial discharge

- point. The second local resident family is assumed to eat locally caught fish and shellfish in addition to terrestrial sourced food.
- ii) Two fisherman families selected to represent the exposure pathways associated with discharges from the UK EPR to the coastal environment. The first fisherman family are assumed to spend time on intertidal sediments in the area and consume high levels of locally caught fish and shellfish. The second fisherman family is assumed to spend time on sediments, eat fish and shellfish and as well as smaller amounts of terrestrial foodstuffs from local sources up to 500 m from the aerial discharge point. These groups live far enough from the site not to be exposed to direct radiation from atmospheric releases.
 - iii) The fifth local resident assessed is a combination of the first group (local farming family eating terrestrial foodstuffs) and the third group) fisherman family eating high levels of locally caught fish and shellfish).
- b) **Habits data**- which includes things such as food consumption rates, breathing rates and occupancy rates for three age groups (1 year old infant, 10 year old child and adult). At existing nuclear sites we have collected habits data to use in our impact assessments. However, for the generic sites, where no site-specific data is available, generic habits data can be used. This data is used to define habits for the exposure groups considered in the assessment. Generic habit data derived from UK national surveys is published in recognised sources such as NRPB-W41. (PCERsc11.1 Tables 9 and 12). Generic habits normally lead to greater exposure than site-specific habits, resulting in higher predicted doses than may be expected for a site-specific assessment.
 - c) **Non-human species** – It is assumed that European and UK protected species may be present including birds, terrestrial mammals, reptiles and amphibians, marine mammals and fish, invertebrates and flora. EDF and AREVA have assumed that all reference organisms specified in the ERICA integrated approach are present (Brown et al, 2008). The use of reference organisms with defined anatomical and physiological properties and habits to represent typical organisms in the ecosystem is an accepted practice in the assessment of impact on non-human species. (PCERsc10.4 Table 2)
 - d) **Meteorology** – Meteorological data has been derived for the generic site which is described as a typical coastal UK location with a uniform windrose and 70% Pasquill category D. Data on atmospheric washout and deposition coefficients have been used which are consistent with data published in recognised sources such as RP72 (EC, 1995). (PCERsc11.1 Table 7)
 - e) **Terrestrial environment** – For GDA, EDF and AREVA have specified the terrestrial environment only in terms of the parameters that need to be defined for prospective radiological impact assessment purposes. For the terrestrial environment a key parameter is surface roughness and this has been assumed to be 0.3 m which is typical of an agricultural location. More detailed information on the terrestrial environment will be made available at the site specific stage. (PCERsc11.1 Table 7)
 - f) **Coastal environment** – EDF and AREVA have examined data for four short listed sites where a UK EPR might be operated. The local waters have been defined using the most restrictive values for parameters such as depth, coastline length, sediment load, rate and density, bioturbation and diffusion rate for potential sites where the UK EPR might be located. Two sets of marine dispersion parameters have been used for dose assessment modelling purpose. For modelling individual dose, EDF and AREVA have used the following parameters:

	Data of each potential site				Retained data for the typical site	
Regional compartment	Irish Sea West	North Sea SW	Cumbrian Waters	Bristol Channel	Most Conservative Regional Compartment	Cumbrian Waters
Marine module	Irish Sea	North Sea	Irish Sea	Bristol Channel	As the regional compartment selected is Cumbrian waters the marine module is Irish Sea	Irish Sea
Local compartment volume (m ³)	2 10 ⁹	3 10 ⁸	2 10 ⁹	5 10 ⁹	Smallest volume	3 10⁸
Local compartment depth (m)	20	10	20	20	Largest depth	20
Local compartment coastline length (m)	1 10 ⁴	1 10 ⁴	2 10 ⁴	3 10 ⁴	Longest coastline length	3 10⁴
Local compartment volumetric exchange rate (m ³ y ⁻¹)	4 10 ¹⁰	1.1 10 ¹⁰	8 10 ¹⁰	110 ¹¹	Lowest volumetric exchange rate	1.1 10¹⁰
Local compartment suspended sediment load (t m ⁻³)	1 10 ⁻⁵	8 10 ⁻⁵	5 10 ⁻⁶	2 10 ⁻⁴	Lowest suspended sediment load	5 10⁻⁶
Local compartment sediment rate (t m ⁻² y ⁻¹)	5 10 ⁻³	1 10 ⁻⁴	1 10 ⁻²	1 10 ⁻⁴	Highest sediment rate	1 10⁻²
Local compartment sediment density (t m ⁻³)	2.6	2.6	2.6	2.6	Typical of all European waters	2.6
Local compartment Bioturbation rate (m ² y ⁻¹)	3.6 10 ⁻⁵	3.6 10 ⁻⁵	3.6 10 ⁻⁵	3.6 10 ⁻⁵	Typical of all European waters	3.6 10⁻⁵
Local compartment diffusion rate (m ² y ⁻¹)	3.15 10 ⁻²	3.15 10 ⁻²	3.15 10 ⁻²	3.15 10 ⁻²	Typical of all European waters	3.15 10⁻²

Note: The regional compartment and marine module are stated to be Cumbrian Waters and Irish Sea however the generic site is a combination of the worst case values for each parameter from the four sets of data in the table above (source of table: TQ-EPR-186).

For modelling collective dose EDF and AREVA have used the following data:

	Data of each potential site				Retained data for the typical site
Regional compartment	Irish Sea West	North Sea SW	Cumbrian Waters	Bristol Channel	North Sea SW
Marine module	Irish Sea	North Sea	Irish Sea	Bristol Channel	North Sea
Local compartment volume (m ³)	2 10 ⁹	3 10 ⁸	2 10 ⁹	5 10 ⁹	3 10⁸
Local compartment depth (m)	20	10	20	20	10
Local compartment coastline length (m)	1 10 ⁴	1 10 ⁴	2 10 ⁴	3 10 ⁴	1 10⁴
Local compartment volumetric exchange rate (m ³ y ⁻¹)	4 10 ¹⁰	1.1 10 ¹⁰	8 10 ¹⁰	110 ¹¹	1.1 10¹⁰
Local compartment suspended sediment load (t m ⁻³)	1 10 ⁻⁵	8 10 ⁻⁵	5 10 ⁻⁶	2 10 ⁻⁴	8 10⁻⁵
Local compartment sediment rate (t m ⁻² y ⁻¹)	5 10 ⁻³	1 10 ⁻⁴	1 10 ⁻²	1 10 ⁻⁴	1 10⁻⁴
Local compartment sediment density (t m ⁻³)	2.6	2.6	2.6	2.6	2.6
Local compartment Bioturbation rate (m ² y ⁻¹)	3.6 10 ⁻⁵	3.6 10 ⁻⁵	3.6 10 ⁻⁵	3.6 10 ⁻⁵	3.6 10⁻⁵
Local compartment diffusion rate (m ² y ⁻¹)	3.15 10 ⁻²	3.15 10 ⁻²	3.15 10 ⁻²	3.15 10 ⁻²	3.15 10⁻²

- 34 EDF and AREVA have used the UK EPR generic site characteristics in their assessment of the potential radiological impact of the UK EPR on members of the public and non-human species.
- 35 In our independent dose assessment carried out on our behalf by Enviro Consulting Ltd (see our report IMAS/TR/2010/05, Environment Agency, 2010a) Table A.2 of Appendix 2 sets out comments on EDF and AREVA's approach to dose assessment which includes comments on the values of generic site parameters used by EDF and AREVA.
- 36 We consider that the UK EPR generic site characteristics are justified and reasonable for the GDA stage and represent a conservative yet realistic approach. We consider the parameters and their values which define the UK EPR generic site are appropriate for use in the assessment of radiological impact at the GDA stage. We recognise that detailed site specific assessments of the radiological impact from the UK EPR will be required at the site specific stage using data and information which relates to the site at which a UK EPR reactor may be located.

2.5 Compliance with our requirements

P&I Table 1 section or REP	Compliance comments
Section 1.3: We require the Generic Site Characteristics that the requesting party wishes us to take into account when assessing the environmental impact of the reactor design. A range of generic sites might be addressed with coastal, estuarine and inland characteristics.	EDF and AREVA provided characteristics and data for their generic site. The values of the generic site parameters used for individual dose assessment and collective dose assessment differed. EDF and AREVA used parameter values resulting in the highest dose in each case. EDF and AREVA proposed a coastal generic site.
SEDP1 General RSR Principle for siting new facilities - When evaluating sites for a new facility, account shall be taken of the factors that might affect the protection of people and the environment from radiological hazards and the generation of radioactive waste.	The generic site proposed by EDF and AREVA considered factors that might affect the protection of people and the environment. The information about the generic site used in the dose assessments seemed reasonable.

3 Public Comments

37 The public involvement process remained open during our assessment see <http://www.hse.gov.uk/newreactors/publicinvolvement.htm>

38 We did not receive any public comments by this route during this assessment relating to the generic site.

39 The issue of more than one reactor at a site was raised at our stakeholder event in July 2010 and by some respondents to our consultation (GDA38, GDA143). GDA is for a single reactor site, EDF and AREVA say in PCERsc10.1: '*GDA only covers a single unit site for the impact analysis. For a potential multi-reactor site, acceptability of the global impact would have to be reviewed and permits would be obtained provided that the results of the site-specific impact studies are acceptable*'.

40 Our response in the Decision Document is:

GDA is based on assessing the environment and safety cases of a single reactor design because this represents the underpinning starting point for any station, whether it has one or more reactors. While for a multiple reactor station there will be some opportunities for certain plant and facilities to be shared, much of the design would be replicated for each reactor. It will be for potential operators to define their proposals for specific sites, including the number of reactors that they intend to construct. The potential operators will have to bring forward applications for site specific permits based on the level of discharges they expect and consideration of what is best available techniques (BAT) for the site specific design they propose. These applications would be informed by GDA submissions and assessments and the specific environmental characteristics of the site proposed to be developed. The site specific characteristics that would have to be addressed in potential operators' assessments include the possibility of cumulative impacts arising from other facilities in the vicinity of the proposed development.

It is normal practice to carry out impact assessments using models and predictions of performance for new reactor designs. These are based in part on actual experience of similar reactors already in operation. A key requirement of our environmental permits is that operators of nuclear power stations must carry out extensive environmental monitoring programmes. These help to ensure that the impacts are well characterised and consistent with projections.

4 Conclusion

41 We consider that the UK EPR generic site characteristics are justified and reasonable for the GDA stage and represent a conservative approach whilst retaining a sufficient amount of realism. We consider the parameters and their values which define the UK EPR generic site are appropriate for use in the assessment of radiological impact at the GDA stage. We recognise that detailed site specific assessments of the radiological impact from the UK EPR will be required at the site specific stage using data and information which relates to the site at which a UK EPR reactor may be located. This is dealt with in our Assessment Reports (EAGDAR UK EPR-11 and EPR-12, Environment Agency, 2011b and 2011c) on the radiological impacts on members of the public and non human species.

42 We conclude that EDF and AREVA's generic site parameters and their values which define their generic site are appropriate for use in their assessment of radiological impact at the GDA stage.

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While every effort has been made to ensure the accuracy of the references listed in this report, their future availability cannot be guaranteed.

Abbreviations

ALARA	As low as reasonably achievable
ALARP	As low as reasonable practicable
BAT	Best available techniques
EPRB	GDA UK EPR – BAT demonstration, document UKEPR-0011-001
EPRB 3.5s1.2	EPRB form 3.3 section 1.2 (example reference)
ERICA	Environmental Risk from Ionising Contaminants: Assessment and Management (outcome of a EURATOM funded project)
FSA	Food Standards Agency
GDA	Generic design assessment
HPA	Health Protection Agency
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IWS	GDA UK EPR – Integrated Waste Strategy Document UKEPR-0010-001 Issue 00
JPO	Joint Programme Office
NDAWG	UK National Dose Assessment Working Group
P&ID	Process and information document
PCER	Pre-Construction Environmental Report
PCERsc3.3s4.1	PCER sub-chapter 3.3 section 4.1 (example reference)
PCSR	Pre-Construction Safety Report
RAMSAR	A site of international conservation importance classified at the 'Convention on Wetlands of International Importance' 1971, ratified by the UK Government in 1976
REPs	Radioactive substances environmental principles
RI	Regulatory Issue
RO	Regulatory Observation
RSA 93	Radioactive Substances Act 1993
RWMD	Radioactive Waste Management Directorate (of NDA)
SPA	Special Protection Areas. An area classified as such under the EC Birds Directive to provide protection to birds, their nests, eggs and habitats; areas that are internationally important sites designated under the EEC Wild Birds Directive.
SSSI	Site of Special Scientific Interest identified / notified by English Nature or the Countryside Council for Wales under the Wildlife and Countryside Act 1981 for its importance to nature conservation
TQ	Technical Query

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