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Considerazioni e aspetti normativi dell'interfaccia safety e security nucleare

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CONSIDERAZIONI E ASPETTI NORMATIVI DELL'INTERFACCIA SAFETY E SECURITY NUCLEARE

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Sommario

Per la prima volta nell'ambito RSE, AdP ENEA-MSE, viene affrontata la tematica dell'interfaccia safety-security che, associata a quella della non proliferazione, viene denominata in ambito internazionale 3S (Safety, Security, Safeguards). Questo rapporto si sofferma su alcune considerazioni di carattere generale su safety e security e loro relazione, anche alla luce delle conseguenze dell'incidente di Fukushima, per poi sviluppare in maggior dettaglio come essa viene riflessa nella normativa nazionale, francese e americana. Si riportano anche le conclusioni di un workshop IAEA sull'interfaccia safety e sacurity nei reattori di ricerca e delle recenti riunioni relative alle convenzioni sulla safety nucleare.

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1 Introduzione

Il tema della security nucleare è stato già affrontato In precedenza in ambito RSE, Accordo di Programma ENEA-MSE, con l'emissione di un rapporto tecnico[1] che, da un lato, presentava un quadro complessivo della security e, dall'altro, prendeva in considerazioni aspetti di security specifici per depositi di rifiuti radioattivi. Per la prima volta, nel contesto RSE, viene ora affrontato con un certo grado di dettaglio il tema della security in relazione della safety nucleare.

In sintesi, la *nuclear safety* afferisce alla prevenzione degli incidenti nucleari, anche a fronte di calamità naturali, e la mitigazione delle relative conseguenze; la *nuclear security* è legata alla protezione da atti di natura dolosa e malevola degli impianti e dei materiali sensibili in essi utilizzati e generati. L'obiettivo finale di entrambe è comune: proteggere le popolazioni e l'ambiente dagli effetti nocivi delle radiazioni ionizzanti.

Sebbene tradizionalmente le competenze per queste due tematiche si trovino in comunità scientifiche diverse e siano gestite separatamente, è ormai generalmente riconosciuta la necessità di un approccio coerente e integrato nell'applicazione delle misure adottate e nell'azione delle rispettive autorità di controllo nazionali.

Per limitare il rischio proveniente da materiali nucleari (e altri materiali radioattivi) e gli impianti associati è opportuna una stretta coordinazione nell'implementazione delle misure di safety e security, ma senza trascurare che ci sono dei limiti a tale integrazione. L'insieme delle misure e procedure da adottare per la safety e security infatti non è completamente sovrapponibile e, mentre in alcune aree si può parlare di un effetto sinergico (es. robustezza dell'impianto contro sabotaggio e furti, piani di emergenza), in altre ci può essere contrapposizione (es. restrizioni di accesso e riservatezza delle informazioni). Sarebbe più corretto parlare di interazione o interfaccia che di sinergia quando si parla della relazione tra loro.

L'incidente all'impianto nucleare Fukushima Daichi di TEPCO ha dato ulteriore evidenza della necessità dell'approccio unitario alle due problematiche.

[1] F.Padoani, "Nuclear Security: un approccio per il deposito nazionale per lo smaltimento di rifiuti radioattivi", Report RSE/2009/133, 2009

2 Safety – Security: Nuclear Security Summit

La relazione tra safety e security, anche se portata da alcuni anni sulla scena internazionale dall'iniziativa giapponese G8 delle 3S (*Safety, Security, Safeguards*) e discussa in diversi fora IAEA, ha assunto una forte rilevanza internazionale solo a seguito dell'incidente di Fukushima.

Tra gli eventi internazionali più significativi si colloca l'*High-level Meeting on Nuclear Safety and Security* convocato dal Segretario Generale delle Nazioni Unite a New York il 22 settembre 2011. Ma è soprattutto il Vertice per la Sicurezza Nucleare (*Nuclear Security Summit*, NSS) che ha portato in primissimo piano e al massimo livello questa problematica.

L'incidente di Fukushima ha avuto infatti un forte impatto sul *Nuclear Security Summit* di Seul, il secondo dopo quello di Washington del 2010, che si è svolto nei giorni 26 e 27 marzo con la partecipazione di 53 Paesi, rappresentati dai Capi di Stato e di Governo, e di quattro organizzazioni internazionali (ONU, AIEA, EU ed Interpol).

La riconsiderazione dei programmi nucleari a livello mondiale, i gravi effetti del rilascio di radiazioni da un impianto nucleare e le difficoltà di risposta anche in un Paese estremamente avanzato come il Giappone hanno portato all'introduzione nell'agenda del Summit del tema della safety e della sua interfaccia con la security. Molti leaders, tra cui il Presidente del Consiglio italiano, sono intervenuti su questo tema al quale è stata dedicata una sessione speciale.

Come esempio del nesso tra safety e security, si sottolineano di seguito due punti che evidenziano come la gestione dell'emergenza a Fukushima abbia dimostrato la necessità di affrontare unitariamente gli aspetti di safety e security prendendo in considerazione in modo integrato i fattori scatenanti, qualunque sia l'evento originatore (incidente, catastrofe naturale o sabotaggio).

- A Fukushima, ad esempio, i controlli per la protezione fisica dei materiali nucleari sono venuti meno per un lungo periodo di tempo, in assenza di un piano predisposto e coordinato unitariamente dalle autorità nazionali di controllo in materia di safety e security e dall'esercente dell'impianto.
- Durante l'incidente sono state fornite molte informazioni sull'impianto, alcune anche molto dettagliate, sui suoi punti di deboli; informazioni che potrebbero essere sfruttate in altri impianti per azioni di sabotaggio o di attacco terroristico. Ad esempio le criticità causate dalla mancanza di alimentazione elettrica e quelle ipotizzate per le piscine di raffreddamento, nel caso di Fukushima imputabili al terremoto-tsunami, potrebbero anche essere provocate ad arte. Riflessioni sulla gestione delle informazioni critiche durante una crisi sono opportune.

L'intervento del Presidente del Consiglio italiano sul tema safety-security è significativo per la sua chiarezza nel fissare alcuni elementi chiave e soprattutto per la sottolineatura della specificità italiana che, caso abbastanza raro, prevede una unico ente di controllo per safety e protezione fisica (passiva) di impianti nucleari. Se ne riportano di seguito i passi principali.

Nuclear Security Summit Seoul, March 26 - 27 2012

Statement by the Prime Minister of Italy
"Nuclear Safety – Security interface"

….

Even if safety and security are distinct issues and have been dealt with separately both at the national and international level, an integrated and coherent approach appears increasingly necessary. This applies both to the measures to be adopted and to the regulatory measures undertaken in the two sectors. The tragic accident at Fukushima Dai-Ichi bears witness to the pressing need for a coordinated approach.

Full integration is hindered by the confidentiality required in managing nuclear security information. This prevents the full transparency which, instead, is required for nuclear safety.

Further steps towards increased integration are feasible and welcome. We should reduce to the minimum the areas which require separate interventions, while ensuring a general coordination in the two fields.

As to nuclear security, the Italian legal and operational framework goes in the right direction by considering separately "active" and "passive" measures of physical protection. The bodies in charge of "passive" protection (i.e. the Ministry of Economic Development and the regulator ISPRA) are also in charge of nuclear safety. With these task assignments, conditions are in place in Italy for a coherent approach to nuclear safety and security by plant operators and regulatory authorities.

It is important, in conclusion, that national regulatory and control systems are structured in a way that the safety-security interface is adequately managed so as to ensure that all measures taken are coordinated and compatible.

3 Safety – Security: IAEA

Per assicurare un approccio coordinato tra safety e security, le attività della IAEA per la nuclear safety e la nuclear security sono gestite da un unico Dipartimento il *Department of Nuclear Safety and Security*.

3.1 Safety

La IAEA ha nel suo mandato, oltre alla verifica del rispetto degli obblighi previsti dal TNP attraverso ispezioni e controlli (salvaguardie) per prevenire la diversione a fini militari di materiali, impianti ed attrezzature nucleari di salvaguardia, anche il compito di sviluppare safety standards e promuovere il raggiungimento e mantenimento di alti livelli di sicurezza (safety) nelle applicazioni dell'energia nucleare.

In particolare, dopo Chernobyl, l'AIEA ha sviluppato un articolato corpo di standards internazionali nel settore della safety nucleare (si noti che tali standards non sono vincolanti) e di servizi a supporto degli Stati. A seguito dell'incidente di Fukushima, l'ultima Conferenza Generale della AIEA ha approvato un Piano d'Azione per la Safety (IAEA *Action Plan on Nuclear Safety*) il cui scopo è la definizione di un programma di lavoro per il rafforzamento del regime internazionale di sicurezza. Tra questi citiamo la valutazione di eventuali vulnerabilità degli impianti nucleari alla luce dell'esperienza di Fukushima (decisa anche, e ancor prima, a livello europeo con i cosiddetti "*stress test*"), la diffusione e applicazione dei safety standards IAEA e il rafforzamento delle missioni di valutazione dell'Agenzia (AIEA *Peer Reviews*).

Il rafforzamento delle convenzioni sulla safety è uno dei punti salienti del Piano d'Azione. Il 2012 è stato un anno di intensa attività per le principali convenzioni:

- *Convention on Early Notification of a Nuclear Accident* e *Convention on Assistance in the Case of a Nuclear Accident of Radiological Emergency*. Il 17-20 aprile a Vienna si è tenuto il sesto incontro dei rappresentanti delle autorità competenti con 150 partecipanti da 71 paesi e 5 organizzazioni internazionali.
- *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* (JC). Il Quarto Review Meeting si è tenuto tra il 14 e 23 maggio (più di 600 partecipanti da 54 paesi contraenti).
- *Convention on Nuclear Safety* (CNS). La Seconda Riunione Straordinaria (*Extra-ordinary*) per la CNS si è svolta dal 27 al 31 agosto. La Riunione Straordinaria è stata decisa al Quinto Review Meeting di aprile 2011 per discutere le "*lesson learned*" fino ad ora individuate dall'incidente di Fukushima e l'efficacia della CNS. Vi hanno partecipato più di 600 delegati da 64 dei 74 paesi contraenti oltre ad EURATOM e la OECD/NEA come osservatori.

Vari paesi hanno presentato delle proposte intese a rafforzare convenzioni e la loro attuazione. Alla Seconda Riunione Straordinaria della CNS, 10 paesi hanno presentato proposte di modifica delle linee guida sfociate nell'adozione di nuove versioni di INFCIRC/571, 572 e 573. Inoltre è stata approvata la creazione di un *Effectiveness and Transparency Working Group* che riporterà alla prossima riunione (*6th Review Meeting* nel 2014) una lista di azioni per rafforzare la CNS e, eventualmente, proposte per emendare la convenzione stessa.

Il *Nuclear Safety and Security Group* del G8 durante la presidenza americana del 2012 si è molto impegnato per coordinare le posizioni dei G8/UE con lo scopo di ricercare un approccio comune sul rafforzamento delle Convenzioni. I punti principali di rafforzamento, presentati sia al *Fourth Review Meeting della Joint Convention* che al Secondo Meeting Straordinario della CNS sono:

1. Indipendenza e efficienza della Autorità di controllo;
2. importanza dei safety standard dell'AIEA negli adempimenti in materia di nuclear safety;
3. periodiche "*peer review missions*" internazionali organizzate dall'AIEA;
4. massima trasparenza nei Rapporti Nazionali.

La Seconda Riunione Straordinaria ha considerato questi punti di primaria importanza tra le "*lesson learned*" dall'incidente di Fukushima e ha deciso di allegare al Summary Report un testo che elabora questi aspetti sotto il nome "*Action-oriented objectives for strengthening nuclear safety*"[2].

Si noti che per i paesi membri della UE i punti descritti sono sostanzialmente coperti dalla Direttiva 2009/71/Euratom.

3.2 Security

La security non è esplicitamente menzionata nel mission statement dell'Agenzia, ma è riconosciuta de facto come parte del suo mandato nonostante le resistenze (ancora in essere) di alcuni stati che percepiscono la security come una potenziale barriera all'uso pacifico dell'energia nucleare. Per migliorare trasparenza e accettabilità, l'AIEA ha creato una serie di ambiti di interazione formali e informali con gli Stati membri quali l'*Advisory Group on Nuclear Security* (AdSec), il forum *Friends of Nuclear Security* e il *Nuclear Security Guidance Committee* (NSGC).

Dal 2001 l'attività dell'AIEA con riguardo alla security nucleare ha subito una forte accelerazione e sono stati approvati in successione *Nuclear Security Plans* triennali per i periodi 2003-2005, 2006-2009 e 2010-2013.

L'attività dell'AIEA in materia di security nucleare fa riferimento all'intero quadro di strumenti internazionali in materia, alcuni dei quali sono stati adottati sotto la sua egida come la Convenzione sulla protezione fisica dei materiali nucleari (CPPNM, 1979) e il relativo Emendamento (2005), o il Codice di Condotta per la sicurezza delle sorgenti radioattive. Anche per strumenti sotto l'egida delle Nazioni Unite, quali la Convenzione per la soppressione degli atti di terrorismo nucleare (ICSANT) 2005) e la Risoluzione del Consiglio di Sicurezza delle Nazioni Unite 1540, la AIEA è chiamata a svolgere una molteplicità di funzioni. In generale, in tutti i principali fora internazionali sulla security nucleare, tra cui il *Nuclear Security Summit*, si sta consolidando il riconoscimento del ruolo guida della AIEA nel coordinamento delle attività sulla security.

[2] http://www.iaea.org/Publications/Documents/Conventions/cns-summaryreport310812.pdf

Assunto che la responsabilità di assicurare la security nucleare compete ai singoli Stati, l'AIEA si prefigge di assistere gli Stati e rafforzare la cooperazione internazionale in particolare con riguardo alle tre seguenti aree: protezione delle istallazioni (sabotaggio) e dei materiali nucleari; rilevazione e risposta in caso di traffici illeciti di materiale nucleare e altro materiale radioattivo; scambio di informazioni e di analisi, inclusa la cooperazione e le attività di valutazione e supporto.

Riguardo quest'ultimo aspetto, lo strumento più importante è la banca dati sui traffici illeciti di materiale radioattivo (*Illicit Trafficking Database* - ITDB), al cui rafforzamento fanno esplicito riferimento il Work Plan di Washington e il Communiqué di Seoul. Di analoga importanza sono la "*Nuclear Security Series*" che raccoglie i documenti di riferimento e le linee guida sviluppate dall'AIEA in collaborazione con gli Stati membri, nonchè l'insieme dei servizi di consulenza e supporto che l'Agenzia mette a disposizione degli Stati membri su richiesta. Tra essi particolare rilievo assume la possibilità di avvalersi dell'assistenza dell'AIEA nel contesto di missioni di valutazioni (*Peer Review Missions* e *Advisory Services*) finalizzate al rafforzamento delle strutture nazionali.

La transizione dal concetto di assistenza agli Stati membri a quello di sostenibilità è un punto cruciale. L'AIEA sta pertanto intensificando le attività di education e training: ad esempio nel solo 2011 si sono tenuti più di 50 corsi con oltre 1200 partecipanti. Tra questi, uno degli eventi più attesi, concretizzatosi su impulso del nostro Ministero degli Affari Esteri, è stato il primo corso dell'*International School on Nuclear Security*, organizzata congiuntamente con il Centro Internazionale di Fisica Teorica di Trieste (ICTP, finanziato per l'80% dal Governo italiano), destinata alla formazione di personale proveniente da Paesi emergenti che intendono avviare programmi nucleari. L'istituzione della Scuola, la prima nel suo genere, era stata annunciata dal Presidente del Consiglio italiano, fra gli impegni del nostro paese, al Summit di Washington.

Una ultima osservazione sulle attività di coordinamento safety e security alla IAEA. Benchè l'*Action Plan on Nuclear Safety*, come testimoniato anche dal nome, non consideri aspetti di security, il rafforzamento del regime di safety che deriva dalla sua attuazione porta implicitamente un rafforzamento del regime globale di safety e security. Inoltre nel corso dell'ultimo anno sono stati prese delle misure per rafforzare internamente il coordinamento, prevedendo opportuni fora quali il *Nuclear Security Guidance Committee*.

3.3 Interfaccia safety-security in reattori di ricerca

La IAEA ha un intenso programma relativo ai reattori di ricerca e safety nel quadro dell'assistenza nell'applicazione del *Code of Conduct on the Safety of Research Reactors* adottato nel 2004 dalla Conferenza Generale della IAEA. Meno estese sono le attività relative alla security per i reattori di ricerca. L'organizzazione del *Workshop on Synergy between Safety and Security of Research Reactors* a novembre 2011 è stato quindi una occasione molto importante per discutere per la prima volta degli aspetti di safety e security e della loro mutua interazione nei reattori di ricerca. I partecipanti provenivano dalle due comunita, esercenti di reattori di ricerca/esperti di safety e esperti di security, e la discussione ha mostrato ancora una volta come sia necessario ancora molto lavoro per fare sì che le due comunità, safety e security, parlino con lo stesso linguaggio.

Infatti, nonostante dovrebbe essere ormai chiaro, e la IAEA fa un grosso sforzo per disseminare il messaggio, che safety e security nucleare hanno in comune lo stesso scopo (proteggere gli individui, la proprietà e l'ambiente dagli effetti dannosi delle radiazioni) e che le misure di safety e security nucleare devono essere implementate tenendo conto l'una dell'altra, il workshop ha mostrato alcune resistenze nel riconoscerne la pari dignità, prediligendo alcuni il concetto ormai superato di una "superiorità" della safety. Bisogna anche riconoscere che per molti operatori di reattori di ricerca (centinaia in operazione e più di 200 con più di 30 anni di vita) le considerazioni sugli aspetti di safety e security sono ancora più esotiche che per gli operatori di reattori di potenza. Pertanto questo tipo di workshop è estremamente utile per il diffondersi di una corretta cultura, soprattutto tra gli addetti ai lavori.

Prima di passare alla descrizione nel paragrafo seguente delle principali conclusioni ufficiali, si sottolineano alcune considerazioni di particolare interesse sulla differenza tra reattori di ricerca e reattori di potenza quando si considerano gli aspetti di safety e security. Differenze che fanno sì che, ad esempio, nel caso di reattori di ricerca normalmente non si usi il *Design-Basis-Threat* (cioè una valutazione della minaccia che comprende la definizione dell'avversario) ma una valutazione della minaccia più semplice.

- La stima delle conseguenze radiologiche causate da un sabotaggio sono un tipico elemento di interfaccia e sinergia tra safety e security. Tuttavia, nel caso di un reattore di ricerca tali conseguenze sono di diversi ordine di grandezza inferiori rispetto ai reattore di potenza, e alcuni paesi (USA ad esempio) non considerano la minaccia sabotaggio per reattori al di sotto di 2 MW di potenza.
- Un'altra differenza sostanziale tra reattori di ricerca e reattori di potenza è nelle risorse allocate per la safety e security, sia in termini finanziari che di risorse umane. Differenza che fa sì che ci sia una attitudine completamente diversa verso questi due aspetti e i loro potenziali punti sinergici o di conflitto. Questo spiega anche una certa mancanza di interesse sul tema da parte degli operatori di reattori di ricerca.

Workshop on Synergy between Safety and Security of Research Reactors

Il *Workshop on Synergy between Safety and Security of Research Reactors* si è tenuto a Vienna il 22–25 Novembre 2011.

L'obiettivo del workshop è stato quello di fornire ai partecipanti informazioni pratiche su come gestire i rischi associati con i reattori nucleari di ricerca dal punto di vista della security e della safety; e su come migliorare la sinergia[3] tra le misure di security e le misure di safety. Il workshop è servito anche come forum per uno scambio d'informazioni, di conoscenze e di esperienze dei partecipanti nella messa in atto di misure di safety e security nei reattori nucleari di ricerca. I partecipanti erano esercenti, specialisti e regolatori responsabili della safety e security dei reattori di ricerca.

[3] Si noti che, come sottolineato nell'Introduzione, parlare di sinergia forse non è il termine più corretto, ma continuiamo qui a utilizzarlo per coerenza con la discussione durante il workshop.

Dopo una breve sessione introduttiva, il workshop è consistito di una sessione plenaria nella quale sono state esposte le presentazioni dei partecipanti. Anche l'ENEA, unica rappresentante italiana, ha presentato lo stato della normativa sia dal punto di vista della security che dal punto di vista della safety[4].

A seguire, i partecipanti sono stati divisi in tre gruppi, ad ognuno dei quali era richiesto di discutere e rapportare un importante argomento relativo alla sinergia tra safety e security per i reattori di ricerca:

- Gruppo A: Concetti e principi di progetto: applicazione della *Defence-in-Depth* (DiD), della *Design-Basis-Accident* (DBA) e della *Design-Basis-Threat* (DBT);
- Gruppo B: Principi Organizzativi (monitoraggio, procedure operative, registrazioni, ecc.); conseguenze radiologiche degli eventi incidentali di safety e security e relativi piani di emergenza;
- Gruppo C: Uso di un approccio graduale nell'applicazione dei requisiti di safety e delle raccomandazioni di security nei reattori nucleari di ricerca.

I risultati dei gruppi di lavoro sono stati poi presentati e discussi, anche in modo molto vivace, in sessione plenaria. Le conclusione e le raccomandazioni dei gruppi di lavoro hanno formato una parte consistente delle conclusioni del workshop.

Le principali conclusioni del workshop sono le seguenti.

1. Il workshop è stato un eccellente foro per condividere informazioni, conoscenze ed esperienze tra i partecipanti su come migliorare la sinergia tra safety e security nei reattori di ricerca. L'incontro ha anche fornito informazioni pratiche sulla gestione dei rischi relativi ai reattori di ricerca dal punto di vista della safety e security. È stato raccomandato all'IAEA di organizzare incontri simili su base regolare (un suggerimento: biennale) e di considerare l'organizzazione di incontri regionali sull'argomento in lingue diverse dall'inglese. Si consiglia all'IAEA di organizzare attività di addestramento sulla security delle Tecnologie per l'informazione e la comunicazione (ICT).

2. Dalle discussioni avute durante il workshop, i partecipanti hanno concluso che:
   - esistono molte similitudini nella gestione della safety e della security nucleare, incluso la supervisione dell'ente regolatore, aspetti organizzativi, concetti e metodi di progettazione, principi operativi, risposta all'emergenza, e il concetto di approccio graduale;
   - l'applicazione corretta dei concetti e criteri di progettazione per la safety nucleare e una buona pratica operativa migliorano la protezione contro il sabotaggio;
   - la cultura della safety e la cultura della security non dovrebbero essere poste in contrapposizione; mutualmente una dovrebbe rinforzare l'altra;
   - attributi specifici in alcune aree della safety e della security nucleare possono condurre a conflitti nell'implementazione di attività rilevanti; questi conflitti dovrebbero essere gestiti opportunamente coordinando i metodi, gli approcci e i principi operativi durante

[4] Presentazione di R. Bove, in collaborazione con F. Padoani

la vita del reattore di ricerca; quando i conflitti sono inevitabili, essi devono essere risolti basandosi sulla filosofia del minimo rischio per il pubblico e l'ambiente.

3. Dalla discussione su come migliorare la sinergia tra la safety e la security è emerso che i punti critici sono:
   - le differenze tra la cultura per la safety e la cultura per la security;
   - la separazione, presente in molti stati (ma non in Italia) tra le autorità preposte al controllo per la safety e le autorità per la security;
   - guide regolatorie inadeguate;
   - mancanza d'integrazione tra safety e security nel processo di progettazione,
   - mancanza di adeguato coordinamento durante l'esercizio dell'impianto.

4. Il workshop ha riconosciuto l'importanza del considerare la sinergia tra safety e security sin dallo stadio iniziale del ciclo di vita, dalla costruzione e attraverso tutte le fasi, dell'impianto. Questo dovrebbe essere raggiunto attraverso un effettivo coordinamento delle attività di safety e security.

5. I partecipanti hanno evidenziato la necessità di guide tecniche su metodi, approcci e buona pratica per il miglioramento continuo della sinergia tra safety e security. A questo riguardo è stato raccomandato all'IAEA di sviluppare un documento tecnico sulla sinergia tra safety e security dei reattori di ricerca. Tale documento dovrebbe fornire una guida sulle aree di similarità e differenze tra la safety e la security e fornire esempi di buona pratica, che potrebbero essere dati senza compromettere la confidenzialità. Viene anche raccomandato all'IAEA di sviluppare un documento sulla categorizzazione dei rischi di safety e security relativi ai reattori di ricerca.

6. Le presentazioni fornite e le discussioni che ne sono seguite hanno mostrato che, nei diversi stati, la supervisione sulla safety e la security sono di competenza di organizzazioni diverse. A questo riguardo è raccomandato un effettivo coordinamento tra le organizzazioni, in particolare per i programmi di ispezione per entrambe safety e security.

7. È stato raccomandato di utilizzare indicatori di prestazioni (performance indicator) per la safety e la security, inclusi indicatori per misurarne la sinergia.

8. Dalle presentazioni e dalla discussione sulle differenze tra le due culture di safety e security è emersa la necessità di una metodologia per la valutazione delle due culture nelle organizzazioni che ospitano reattori di ricerca.

9. Riguardo gli aspetti di riservatezza delle informazioni associata alla security, è stato fatto notare che spesso questa è usata come una scusa per non discutere le questioni di security. I partecipanti al workshop sono stati del parere che, con le opportune cautele, ci sia comunque la possibilità di scambio d'informazioni su aspetti relativi alla security, senza violare la riservatezza imposta su alcuni aspetti.

10. La preparazione e la risposta all'emergenza, compresa l'integrazione degli aspetti di safety e security, vanno rafforzati. Sebbene la risposta ad eventi relativi alla safety e alla security

presenti aspetti diversi, vanno considerati entrambi gli aspetti nello sviluppo piani di emergenza. Esercitazioni di emergenza generale dovrebbero essere organizzati in modo da poter efficacemente valutare l'adeguatezza del piano di emergenza.

11. Per quanto riguarda la formazione e la qualificazione degli operatori dei reattori di ricerca e delle autorità di regolamentazione, i partecipanti al workshop hanno concluso che, nella maggior parte delle loro organizzazioni, il personale responsabile per la safety nucleare non è addestrato per supportare la risposta agli eventi di security, e viceversa le personale addetto alla security non è addestrato a sostenere le azioni di safety. Inoltre, vi è una netta difficoltà a fare apprezzare, al personale, i rischi per la safety in modo diverso rispetto ai rischi per la security. A questo proposito, viene raccomandato che tali questioni vengano incluse nel programma di formazione del personale di servizio così come briefing periodici in materia di sicurezza integrata. Tutto ciò per la sicurezza globale integrata dei reattori di ricerca.

12. Considerando il fatto che la maggior parte delle organizzazioni operanti i reattori di ricerca sono in genere di piccole dimensioni ed hanno a disposizione risorse limitate, viene consigliato all'IAEA di proseguire gli sforzi per rompere l'isolamento di queste organizzazioni attraverso l'istituzione di meccanismi di condivisione delle informazioni, tra cui la safety e la security, e sponsorizzare lo sviluppo di una banca dati sugli atti dolosi portati a impianti asserviti a reattori nucleari di ricerca, prendendo in considerazione gli aspetti di riservatezza di chi fornisce le informazioni.

4 Safety – Security: esempi di legislazione e normativa nazionali

I paesi con i maggiori programmi nucleari (Francia e USA) hanno fatto sforzi consistenti per individuare i punti comuni tra safety e security e assicurare che i conflitti tra le esigenze di entrambe siano presi in considerazione e risolti possibilmente all'origine. Infatti sarebbe catastrofico un conflitto di competenze e mancanza di chiarezza su chi è responsabile e di che cosa proprio durante una crisi. Le normative in entrambi gli stati sono state modificate e aggiornate sia per tenere conto delle più recenti raccomandazioni in materia di security sia per chiarire le diverse responsabilita e rafforzare, pur nelle sue differenze, la cultura della nuclear safety e security o, come la lingua italiana molto opportunamente ci consente, della sicurezza nucleare.

Un esempio eccellente di buona pratica è quello francese. L'IRSN, ad esempio, oltre a fornire il suo contributo di esperienza alla comunità internazionale (IAEA in primis) su questo tema, fa opera di formazione a livello nazionale per aumentare una cultura della sicurezza che consideri sia aspetti di safety che security. Molto ben fatte sono ad esempio le pubblicazioni seguenti e disponibili sul sito IRSN.

A queste si aggiungono le periodiche esercitazioni congiunte safety-security che sono fondamentali per garantire un vero coordinamento durante una emergenza. Un esame dettagliato di questi aspetti e della recentissima normativa francese, in particolare sulla security, anche in relazione a quella italiana è oggetto dello studio presentato nell'Appendice. Si deve ringraziare l'IRSN per la disponibilità a fornire tutto il materiale necessario.

Nel caso degli Stati Uniti, la *Nuclear Regulatory Commission* (NRC) è stata la prima a riconoscere la necessità di coordinare gli aspetti di safety e security in modo da risolvere eventuali conflitti. Il riquadro sotto mostra la NRC News del 2008 e in grassetto la parte rilevante sull'interfaccia safety-security.

NRC NEWS

U.S. NUCLEAR REGULATORY COMMISSION
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No. 08-227 December 17, 2008

NRC APPROVES FINAL RULE EXPANDING SECURITY REQUIREMENTS FOR NUCLEAR POWER PLANTS

The Nuclear Regulatory Commission today approved a rule that enhances security requirements for nuclear power reactors. Many of the requirements of this rule are similar to those previously imposed by orders issued after the terrorist attacks of Sept. 11, 2001.

The new rule adds several new requirements as a result of experience in implementing previous security orders and updates the regulatory framework in preparation for the licensing of new nuclear power plants.

In addition, the new rule resolves three petitions for rulemaking that were considered during the development of the final rule.

The final rule is the result of more than four years of work, three public meetings and several opportunities for public comment. Significant stakeholder feedback was received during the process, which resulted in changes to the content, format and organization of the final rule.

Significant features in this rule include a safety/security interface section that requires plants to manage plant activities to avoid potential adverse interactions between security activities and other plant activities. Additionally, there are new sections requiring a comprehensive cyber security program at nuclear power plants, and a requirement that plants develop strategies and response procedures to address an aircraft threat or loss of large areas of the facility due to explosions and fire. New training and qualification requirements for security personnel are also included.

The new rule incorporates portions of a petition for rulemaking submitted by the Union of Concerned Scientists (UCS) and the San Luis Obispo Mothers for Peace to require licensees to evaluate whether proposed changes, tests, or experiments cause protection against radiological sabotage to be decreased and, if so, to conduct such actions only with NRC approval.

A second petition, submitted by Three Mile Island Alert, asked the NRC to require licensees to post at least one armed guard at each entrance to "owner controlled areas." The final physical security requirements in the new rule give licensees flexibility to determine if such personnel postings are necessary. A third petition for rulemaking, focusing on site access authorization and also submitted by the UCS was considered but the recommendations were ultimately not adopted.

The rule will go into effect 30 days after publication in the Federal Register, with licensees given a period of time to update their security plans to be compliant.

La decisione del 2008 si è poi trasformata in requisiti specifici sull'interfaccia safety-security per reattori nucleari nel 2009, continuamente aggiornati.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Home > NRC Library > Document Collections > NRC Regulations (10 CFR) >Part Index > § 73.58 Safety/security interface requirements for nuclear power reactors.

§ 73.58 Safety/security interface requirements for nuclear power reactors.

(a) Each operating nuclear power reactor licensee with a license issued under part 50 or 52 of this chapter shall comply with the requirements of this section.

(b) The licensee shall assess and manage the potential for adverse effects on safety and security, including the site emergency plan, before implementing changes to plant configurations, facility conditions, or security.

(c) The scope of changes to be assessed and managed must include planned and emergent activities (such as, but not limited to, physical modifications, procedural changes, changes to operator actions or security assignments, maintenance activities, system reconfiguration, access modification or restrictions, and changes to the security plan and its implementation).

(d) Where potential conflicts are identified, the licensee shall communicate them to appropriate licensee personnel and take compensatory and/or mitigative actions to maintain safety and security under applicable Commission regulations, requirements, and license conditions.

[74 FR 13987, Mar. 27, 2009]

Più recentemente gli Stati Uniti si sono molto impegnati nel rafforzamento della cultura della sicurezza per gli operatori nucleari, con il coinvolgimento del *Nuclear Energy Institute* (NEI) che fra i propri membri annovera i più importanti rappresentanti dell'industria nucleare sia negli Stati Uniti (ivi incluse tutte le società elettriche che gestiscono impianti nucleari), sia in ambito internazionale. Il NEI ha sviluppato delle linee guida (NEI 09-07: *Fostering a Strong Nuclear Safety Culture*) per l'industria nucleare americana che volontariamente ha deciso di mettere in atto (dal 2012) un sistema per la valutazione della cultura della sicurezza (safety) negli impianti dei reattori nucleari americani. L'*Institute of Nuclear Power Operations* (INPO) è responsabile della valutazione della loro attuazione da parte degli esercenti – cioè coloro che sono riconosciuti dalla legislazione internazionale vigente come i primi responsabili a fronte di situazioni incidentali.

Un ulteriore rafforzamento della cultura della sicurezza deriva dall'approvazione da parte della *NRC* del *Nuclear Safety Culture Policy Statement* (NSPS) pubblicato il 14 giugno 2012 (NRC–2010–0282): la NRC è ora impegnata in un robusto piano di comunicazione e formazione per la sua disseminazione. Il *policy statement*, pur relativo alla sola safety, nel preambolo elabora anche la relazione tra safety e security, entrambe alla base dei compiti regolatori del NRC. Si noti che la NRC considera il preambolo sufficiente a coprire adeguatamente l'aspetto security per la quale non intende produrre un *policy statement* separato.

L'importanza di radicare in profondità i concetti della cultura della sicurezza per rafforzare la sicurezza degli impianti è ben espressa nel testo di questo statement di cui si riportano qui alcune parti, incluse quelle sul rapporto safety-security che è particolarmente ben argomentato.

NUCLEAR REGULATORY COMMISSION [NRC–2010–0282]
Final Safety Culture Policy Statement

Sul legame tra rafforzamento della sicurezza e cultura della sicurezza:

The accident at the Chernobyl nuclear power plant in 1986, brought attention to the importance of safety culture and the impact that weaknesses in safety culture can have on safety performance. Since then, the importance of a positive safety culture has been demonstrated by a number of significant, high-visibility events worldwide. In the United States, incidents involving the civilian uses of radioactive materials have not been confined to a particular type of licensee or certificate holder, as they have occurred at nuclear power plants and fuel cycle facilities and during medical and industrial activities involving regulated materials. Assessments of these incidents revealed that weaknesses in the regulated entities' safety cultures were an underlying cause of the incidents or increased the severity of the incidents. The causes of these incidents included, for example, inadequate management oversight of process changes, perceived production pressures, lack of a questioning attitude, and poor communications. One such incident indicated the need for additional NRC efforts to evaluate whether the agency should increase its attention to reactor licensees' safety cultures. This resulted in important changes to the NRC's Reactor Oversight Process (ROP). Commission paper SECY–06–0122, dated May 24, 2006, (ADAMS Accession No. ML061320282) describes the NRC's safety culture activities at that time and the outcomes of those activities.

Following the terrorist attacks of September 11, 2001, the Commission issued orders enhancing security at facilities whose operations, if attacked, could have an impact on public health and safety. During the early years of implementation of these security enhancements, several violations of the Commission's security requirements were identified in which the licensee's failure to cultivate a positive safety culture impacted the effectiveness of the licensee's security program. The most visible of these involved security officers sleeping in a ''ready room'' while on shift at a nuclear power plant. Most of the weaknesses involved inadequate management oversight of security, lack of a questioning attitude within the security organization, complacency, barriers to raising concerns about security issues, and inadequate training of security personnel.

Sul legame tra safety e security:

The purpose of this Statement of Policy is to set forth the Commission's expectation that individuals and organizations establish and maintain a **positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations and functions**. This includes all licensees, certificate holders, permit holders, authorization holders, holders of quality assurance program approvals, vendors and suppliers of safety-related components, and applicants for a license, certificate, permit, authorization, or quality assurance program approval, subject to NRC authority. The Commission encourages the Agreement States, Agreement State licensees and other organizations interested in nuclear safety to support the development and maintenance of a positive safety culture, as articulated in this Statement of Policy.

Nuclear Safety Culture is defined as "*the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment*". Individuals and organizations performing regulated activities bear the primary responsibility for safety and security. The performance of individuals and organizations can be monitored and trended and, therefore, may be used to determine compliance with requirements and commitments and may serve as an indicator of possible problem areas in an organization's safety culture. The NRC will not monitor or trend values. These will be the organization's responsibility as part of its safety culture program.

Organizations should ensure that personnel in the safety and security sectors have an appreciation for the importance of each, emphasizing the need for integration and balance to achieve both safety and security in their activities. **Safety and security activities are closely intertwined. While many safety and security activities complement each other, there may be instances in which safety and security interests create competing goals. It**

is important that consideration of these activities be integrated so as not to diminish or adversely affect either; thus, mechanisms should be established to identify and resolve these differences. A safety culture that accomplishes this would include all nuclear safety and security issues associated with NRC- regulated activities.

Experience has shown that certain personal and organizational traits are present in a positive safety culture. A trait, in this case, is a pattern of thinking, feeling, and behaving that emphasizes safety, particularly in goal conflict situations, e.g., production, schedule, and the cost of the effort versus safety. **It should be noted that although the term ''security'' is not expressly included in the following traits, safety and security are the primary pillars of the NRC's regulatory mission. Consequently, consideration of both safety and security issues, commensurate with their significance, is an underlying principle of this Statement of Policy.**

A livello nazionale, uno degli elementi di originalità della nostra normativa è la distinzione tra protezione fisica attiva e passiva. Infatti, il nostro ordinamento in materia di *nuclear security* distingue la "protezione fisica attiva" e la "protezione fisica passiva", separandone lin modo netto ruoli e responsabilità. La prima si riferisce alla protezione assicurata dalle Forze dell'Ordine per impedire atti di sottrazione illecita o di sabotaggio contro materiali e installazioni nucleari, la seconda è intesa come la protezione fornita dalle strutture, dai sistemi e dalle procedure di sorveglianza presso le installazioni nucleari per proteggere i materiali e gli impianti nucleari da atti di sottrazione illecita e di sabotaggio. La competenza sulla protezione attiva fa capo al Ministero dell'Interno, mentre la competenza sulla protezione passiva fa capo attualmente al Ministero dello Sviluppo Economico e a ISPRA, con attribuzioni autorizzative e regolamentari, di supporto tecnico e di controllo, analoghe a quelle esercitate dalle stesse due istituzioni per gli aspetti di *nuclear safety*. Questa divisione è vista con molto interesse anche dalla IAEA che in varie occasioni ha notato come questo potrebbe essere un esempio di buona pratica, particolarmente per i paesi che stanno iniziando programmi nucleari.

Questa divisione infatti oltre a distinguere chiaramente le competenze tra diverse Agenzie, pone i presupposti per un approccio coerente e integrato di nuclear safety e security, da parte dell'esercente degli impianti e delle autorità regolamentari e di controllo

L'Appendice contiene una approfondita e aggiornata descrizione degli strumenti internazionali alla base del regime internazionale di safety e securiy o, in linguaggio IAEA, del *Global nuclear safety and security framework*. La sua parte più corposa è lo studio dettagliato della normativa sulla security nucleare, e gli aspetti comuni con la safety, di Francia e Stati Uniti cui viene rapportata la legislazione italiana vigente e attualmente in discussione.

5 Conclusioni

Il legame tra safety e security presenta ancora molti aspetti da approfondire. Un messaggio chiave è che è indispensabile che non ci si dimentichi mai, sotto la spinta di una emergenza (come il 9/11 o l'incidente Fukushima), che entrambi questi aspetti sono essenziali per garantire un efficace ed effettivo regime internazionale di sicurezza, ovvero safety and security.

6 ALLEGATO - Safety and security at nuclear facilities: the legislative framework

Safety and security at nuclear facilities: the legislative framework

Dr. Fabiana Rossi

20th August 2012

1 Nuclear Safety and Security Regime

The application of nuclear energy for electricity generation started with national programs in a few pioneering countries in the mid-1950s. Major worldwide expansion of nuclear power took place in the late 1960s and early 1970s, with a variety of reactor types and safety approaches. Since then, international cooperation has gradually increased, and has led to a substantial convergence of the design and operating principles for nuclear power plants [1].

The necessity to involve all countries as active partners in a single global nuclear safety regime became evident after the accident at the Chernobyl Nuclear Power Plant, while recent terrorist events have served as a catalyst for the development of the global nuclear security regime, that is not as mature as the safety regime. Although concern about malicious acts involving nuclear installations is not new, recent terrorist events have demonstrated that an attack on a nuclear facility might be attempted and that terrorists have formidable capabilities and dedication. This has led to an increased focus on defences against terrorists at nuclear facilities, as well as at other critical infrastructures [2].

Nowadays, several international conventions relevant to nuclear safety and security have been signed, and much progress has been achieved in the joint development of safety and security regulations and in the establishment of international networks among nuclear power plant operators and national regulators.

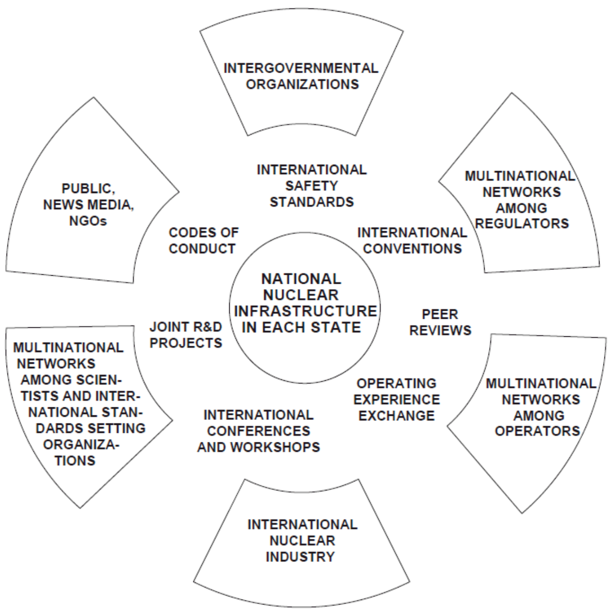


Fig. 1.1: Main elements of the Global Nuclear Safety Regime.

1.1 Global Nuclear Safety Regime

The Global Nuclear Safety Regime is defined as the institutional, legal and technical framework for ensuring the safety of nuclear installations throughout the world. The objective of this regime is to lead to a world where all nuclear installations are operating safely. A schematic picture of the Global Nuclear Safety Regime is presented in Figure 1.1. Its central and most important component continues to be a strong national nuclear infrastructure in each Member State. The active participants in each country's national infrastructure include:

- Operators of nuclear facilities;
- Nuclear safety regulators;
- Scientific and technical support organizations;
- Research organizations and universities;
- Suppliers of equipment and services;
- Other stakeholders with interests in securing nuclear safety.

International participants in the Global Nuclear Safety Regime are:

- Intergovernmental organizations dedicated to the nuclear field, such as the International Atomic Energy Agency (IAEA) and the Organization for Economic Co-operation and Development/Nuclear Energy Agency (OECD/NEA);
- Multinational networks among regulators, such as the International Nuclear Regulators Association (INRA), the Network of Regulators of Countries with Small Nuclear Programmers (NERS), the Western European Nuclear Regulators Association (WENRA) and the Forum of the State Nuclear Safety Authorities of the Countries Operating WWER Type Reactors;
- Multinational networks among operators, such as theWorld Association of Nuclear Operators (WANO), the "Owners groups" of different types of nuclear power plants vendors and the International Network for Safety Assurance of Fuel Manufacturers (INSAF);
- Stakeholders in the international nuclear industry, such as the Nuclear power plant vendors, The World Nuclear Association, the Suppliers of equipment and the Suppliers of services;
- Multinational networks among scientists;
- The public and the news media;
- Non-governmental organizations (NGOs);
- International standards setting organizations.

The assurance of nuclear safety is reinforced by a number of intergovernmental agreements. These include some Conventions that are legally binding on the participating States. Since 1986, some legally binding conventions that have the aim of increasing nuclear safety and security worldwide have been ratified in the areas of nuclear, radiation and waste safety. These are the (see Figure 1.2 [3]):

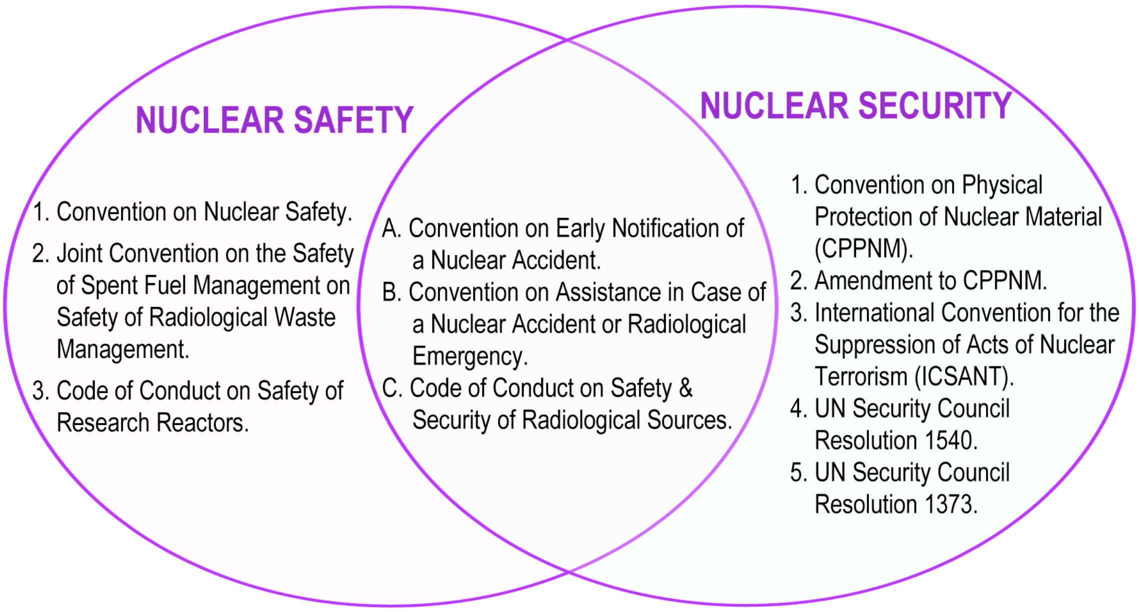


Fig. 1.2: Intersection of Nuclear Safety and Nuclear Security Regime Elements.

- Convention on Early Notification of a Nuclear Accident – 1986 [4] (9 States are signatory, 3 are signatory with reservation; 63 States are party and 47 are party with reservation - data from the IAEA Office of Legal Affairs and are update at the July 03, 2012);
- Convention on Assistance in the Case of Nuclear Accident of Radiological Emergency – 1987 [4] (9 States are signatory, 1 are signatory with reservation; 49 States are party and 55 are party with reservation - data from the IAEA Office of Legal Affairs and are update at the July 03, 2012);
- Convention on Nuclear Safety (CNS) – 1994 [5] (10 States are signatory; 71 States are party and 3 are party with reservation - data from the IAEA Office of Legal Affairs and are update at the July 03, 2012);
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management – 2001 [6] (3 States are signatory; 59 States are party and 3 are party with reservation - data from the IAEA Office of Legal Affairs and are update at the July 03, 2012).

In addition, there are Codes of Conduct that the IAEA General Conference has endorsed and that several Member States are politically committed to observe:

- Code of Conduct on the Safety and Security of Radioactive Sources – 2004 [7] (see Figure 1.3);
- Code of Conduct on the Safety of Research Reactors – 2004 [8].

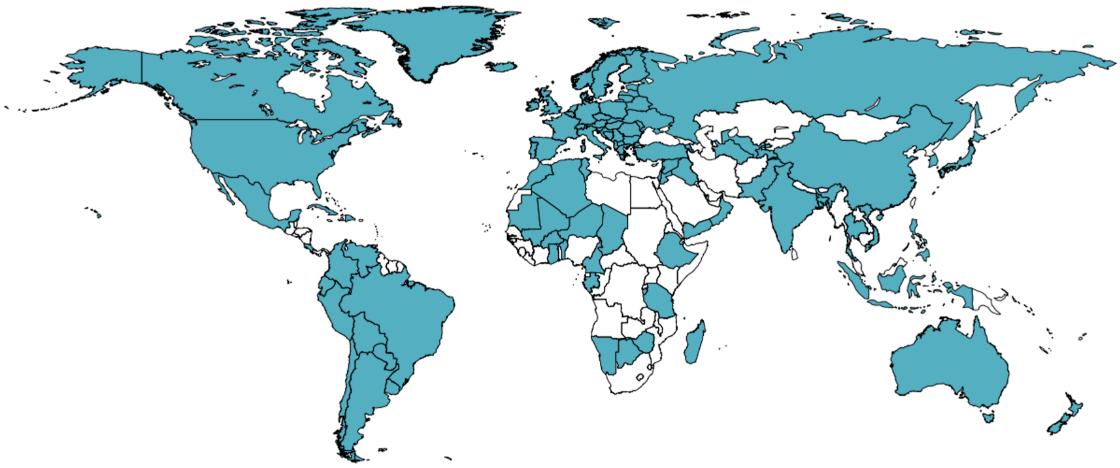


Fig. 1.3: International support for the CCSSRS (as of 06 May 2010).

1.2 Global Nuclear Security Regime

The overall objective of a State's Nuclear Security Regime is to protect persons, property society, and the environment from malicious acts involving nuclear material and other radioactive material.

The Global Nuclear Security Regime comprises international legal instruments, including conventions and codes of conduct and the IAEA Nuclear Security Series publications, supplemented by IAEA security services. IAEA started publishing security related recommendations in 1972 in The Physical Protection of Nuclear Material and Nuclear Facilities [9], which has since been revised several times [10]. Many bilateral nuclear cooperation agreements and the Convention for the Suppression of Acts of Nuclear Terrorism as the United Nations Security Council Resolutions require States to take these recommendations into account when adopting measures to protect nuclear material.

After that, IAEA has established a Nuclear Security Programme and instituted a series of publications on nuclear security to provide recommendations and guidance that States can use in establishing, implementing and maintaining their national nuclear security regime. This Nuclear Security Series framework comprises four tiers of publications: Nuclear Security Fundamentals, Recommendations, Implementing Guides and Technical Guidance. The most important document in the protection of nuclear material and nuclear facilities is the Revision 5 of the INFCIRC\225 that is published in the IAEA Nuclear Security Series [11].

Some international instruments described in section 1.1 are relevant not only for the nuclear safety, but also for the nuclear security. These are the (see Figure 1.2):

- Convention on Early Notification of a Nuclear Accident – 1986 [4];
- Convention on Assistance in the Case of Nuclear Accident of Radiological Emergency – 1987 [4];
- Code of Conduct on the Safety and Security of Radioactive Sources – 2004 [7].

- Other international instruments, instead, are related only to nuclear security. These are:
- Convention on the Physical Protection of Nuclear Material (CPPNM) – 1987, scope extended 2005 [12] (94 States are party and 49 are party with reservation - data from the IAEA Office of Legal Affairs and are update at the July 03, 2012);
- Amendment to the Convention on the Physical Protection of Nuclear Material [13] (54 States are contracting and 2 are contracting with reservation - data from the IAEA Office of Legal Affairs and are update at the July 03, 2012);
- International Convention for the Suppression of Acts of Nuclear Terrorism [14] (139 States partecipate - data from the United Nations Treaty Section and are update at the July 02, 2012);
- United Nations Security Council Resolution 1540 [15] (dealing with the weapon of mass destruction);
- United Nations Security Council Resolution 1373 [16] (requires member States to take measure tending to fight against the terrorism and to control their borders).

1.3 Responsabilities for safety and security

The legal and regulatory framework on wich safety and security are built, should define the responsibilities of several organizations: the State, the regulatory authority or authorities, and the operating organizations. These are summarized taking into account the INSAG-24 [2], the WINS document [17], the Handbook on Nuclear Law [18, 19] and the INFCIRC/225 Rev. 5 [20]. An example of organisations in nuclear security, as suggested by WINS, is given in Figure 1.4 [17].

Responsibility of the state.

The State must set up an appropriate legislative and regulatory framework to ensure control of nuclear power plants, as well as of the transport and uses of nuclear material that present a radiological risk and thus require safety and security provisions. It must designate a regulatory authority or authorities in both the safety and security fields and provide the regulator(s) with the authority, competence and the financial and human resources necessary to accomplish their tasks. Moreover, they should be independent from nuclear operators and other government entities responsible for promoting nuclear power or the use of radioactive material. The State must verify that the responsibilities in safety and security are well defined and are satisfied and must also define rules for confidentiality and information protection in the security area and carry out checks to ensure the trustworthiness of personnel.

The State plays also a critical role in ensuring adequate protection against terrorist threats. The State is directly involved in the assessment of the risk and nature of a potential terrorist attack. The risk of a terrorist event may vary over time, requiring the State to ensure that the security measures are suited to the threat situation. To address this, the State typically defines a design

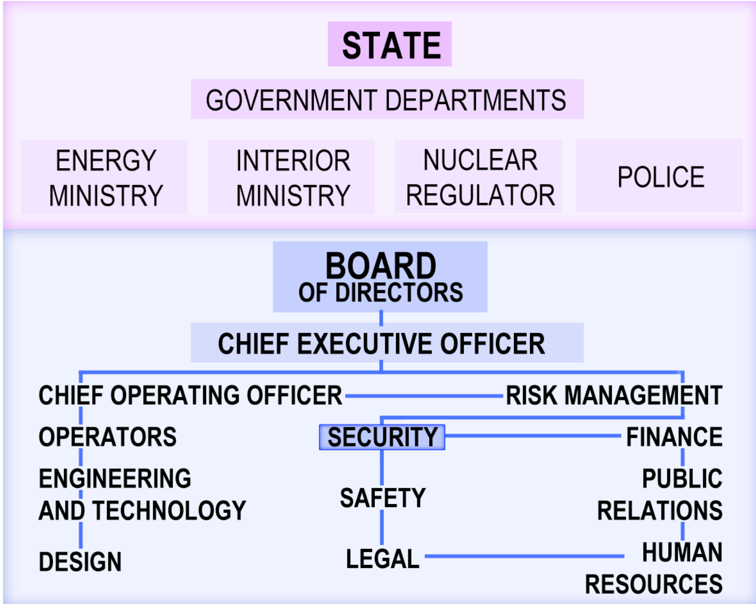


Fig. 1.4: Example of organisation in nuclear security.

basis threat that must be met by the operator, with guidance as to how to adjust the defensive capability to account for the threat situation. In addition, the State must be prepared to augment the defensive capability of the operator in the event of an attack and, if necessary, to execute an operation to seize back control over the plant. If the threat is a theft of material, the State must participate in national and international programmes to prevent the theft, or to recover stolen material.

Responsibility of the regulatory authorities

The regulator (or regulators) must define the requirements to be satisfied by the operator for both safety and security. The regulator must also set up and implement a licensing system and an inspection and enforcement system. The regulator must ensure that an adequate emergency response system is in place, including various off-site elements that are not the responsibility of the operator. In both the safety and security fields the regulator must also observe international commitments.

Because of the close relationship between safety and security, many countries see advantages in having a single regulator responsible for both. This authority may, in turn, be dependent on other government entities for assistance on security matters. That is, a regulator with responsibility for safety and security might be dependent on intelligence information from a specialized agency or 8 agencies. It may also turn to police or military entities for fighting capability to augment the operator’s security forces. In the event that the security regulator is separate from the safety authority, it is essential to have a consultation and coordination mechanism between the two regulators to ensure that regulatory requirements are compatible and serve optimally to advance both safety and security.

Responsibility of operators

The operating organization has the prime responsibility for the safety and security of the nuclear power plant, although in the case of security, the operator's responsibility may be limited to defence against a design basis threat. This allocation of responsibility reflects the reality that operating staff are in the best position to identify the risks arising at the nuclear power plant and to ensure compliance with regulatory requirements. In this context, the operators must:

- Design, implement and maintain technical solutions and other arrangements to satisfy regulatory requirements related to both safety and security;
- Ensure first level control;
- Verify the skills and appropriate training of personnel;
- Inform the regulatory authorities of any event likely to affect the safety or security of the nuclear power plant and, as appropriate, request support;
- Maintain coordination with State organizations that are involved in safety or security; and
- Implement a quality assurance system in both the safety and security fields.

Operators should have a centralized information system and a centralized command centre for directing operations during a safety or security event.

2 Safety and security in nuclear facilities

Nuclear safety and nuclear security have a common purpose: the protection of people, society and the environment. In both cases, such protection is achieved by preventing a large release of radioactive material.

For nuclear safety and security, in the IAEA glossary [21], the following definitions are found:

- Safety: "The achievement of proper operating conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards."
- Security: "The prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities."

Safety evaluations focus on risks arising from unintended events initiated by natural occurrences (such as earthquakes, tornadoes, or flooding), hardware failures, other internal events or interruptions (such as fire, pipe breakage, or loss of electric power supply), or human mistakes (such as the incorrect application of procedures, or incorrect alignment of circuits). In the case of security, the risks, or events, feared arise from malicious acts carried out with the intent to steal material or to cause damage. Security events are therefore based on "intelligent" or "deliberate" actions carried out purposely for theft or sabotage and with the intention to circumvent protective measures.

2.1 Defence in Depth

The acceptable risk is presumptively the same whether the initiating cause is a safety or a security event. The philosophy that is applied to achieve this fundamental objective is similar. Both safety and security typically follow the strategy of "Defence in Depth".

The fundamental nature of the layers is similar. Priority is given to prevention. Second, abnormal situations need to be detected early and acted on promptly to avoid consequent damage. Mitigation is the third part of an effective strategy. Finally, extensive emergency planning should be in place in the event of the failure of prevention, protection and mitigation systems. Defence in depth for the safety of nuclear power plants is described in INSAG-10 [22]:

> *"All safety activities, whether organizational, behavioural or equipment related, are subject to layers of overlapping provisions so that if a failure should occur it would be compensated for or corrected without causing harm to individuals or the public at large."*

Defence in depth for security, instead, is discussed in the Amendment to the CPPNM [13], and outlined in INFCIRC/225 [10]. Defence in depth involves the establishment of a series of protection layers around potential targets for sabotage or theft. This approach takes into account the robustness of systems, structures and components (SSCs) by designing protection systems against adversary capabilities, considers accident management measures and containment systems, and endeavors to protect the function of these SSCs through physical protection measures. Systems for continuous monitoring and early alerts of a possible attempt to circumvent or cause the failure of a protection layer are an integrated part of prevention. The first line of defence for security consists of deterrence steps that serve to discourage an aggressor from attempting an attack. The second line of defence is to implement a security plan that prevents an aggressor from succeeding in an attack or, at the least, delays the aggressor for a sufficient period as to allow external support from police forces to arrive. These security plans typically entail a comprehensive strategy for the defence of the facility from an attack at the level of the design basis threat. Defence against threats beyond the design basis involve extensive coordination between the facility personnel and off-site reinforcements. Security plans for a nuclear power plant should encompass not only the prevention of malicious acts, but also the specification of effective response measures (so-called contingency plans), including, for example, securing a site. There is a need to ensure that the security plan is compatible with and complementary to the safety plan and it is necessary to ensure that coordination is organized among both safety and security responders as part of overall emergency planning. Accordlyng to the CPPNM and the INFCIRC 225, contingency plans should be prepared at three levels: on-site; off-site at the local level; and at the national level both by operator and State to effectively respond to the assumed threat and must be tested via exercises comprising scenarios including safety and security issues.

The on-site contingency plan should be prepared and implemented by site operators and should include the guard force under its responsibility. It should ideally focus on the prevention of any actions leading to radiological consequences. On-site plans should be approved by the Member States competent authority. At the local level, off-site, the contingency plan should be prepared and implemented by local State representatives in liaison with local responders. Contingency and emergency plans must cover, as appropriate, communication with the public, counter-measures off-site, treatment of casualties, and the policing response and investigation [23].

Many of the principles to ensure protection are common, although their implementation may differ. Moreover, many elements or actions serve to enhance both safety and security simultaneously. For example, the containment structure at a nuclear power plant serves to prevent a significant release of radioactive material to the environment in the event of an accident, while simultaneously providing a robust structure that protects the reactor from a terrorist assault. Similarly, controls to limit access to vital areas not only serve a safety function by preventing or limiting exposures of workers and controlling access for maintenance to qualified personnel, but also serve a security purpose by inhibiting unauthorized access by intruders. Such controls may be of particular importance in the security context because the high radiation doses that might be encountered in a vital area may not be a significant deterrent given the apparent willingness of terrorists to forfeit their lives to achieve their objectives.

Nonetheless, there are also circumstances in which actions to serve one objective can be antagonistic to the achievement of the other. For example, the introduction of delay barriers for security reasons can limit rapid access to respond to a safety event or can limit emergency egress by plant personnel. Indeed, security considerations might serve to bar plant personnel from certain areas of the facility in the event of an attack that might need to be accessed for safety reasons. The establishment of fighting positions could adversely affect safety if the field of fire affects critical safety equipment or access to that equipment [2].

2.2 Plant's lifetime phases

There are different challenges that arise in the various phases of a plant's lifetime.

Siting

The site should be assessed for safety purposes by considering the frequency and severity of various external natural and human induced events that could affect the safety of the nuclear power plant; for security purposes by considering the vulnerability to assault of the site. For certain types of threat, the location and layout of the plant site may limit the likelihood that particular on-site areas will be affected, but some site conditions may benefit adversaries, such as the proximity of nuclear power plants to public transport infrastructure (roads, railways and airports) or to industry and populated areas. Other

factors might include consideration of whether some areas within a country are more prone to terrorist activities or unrest than others or whether a given site is near the border with an unfriendly country or a country where terrorist activities are frequent. The final selection of a site for a nuclear power plant should take into account both safety and security assessments.

Design

Nuclear power plants are designed by applying the defence in depth principle for both safety and security (as described in Section 2.1).

Construction

Careful oversight must be exercised during initial construction. Such scrutiny serves to ensure that the plant is constructed as designed, thereby serving both safety and security purposes. This scrutiny should prevent the inadvertent or intentional introduction of weaknesses that could result in a radiological release during operation. Such oversight can present a major challenge because of the large number and diversity of workers entering the site during a construction period.

Operation and decommissioning

Operation must be conducted in a fashion that ensures that both safety and security functions are accomplished. The obligation to ensure safety and security extends over the lifetime of the facility, moreover, the safety obligation continues until all radiological hazards have been addressed. Special obligations may arise during periods in which extensive plant modifications are under way. During such activities, many contractors may need to enter the vital area of the plant, resulting in the need for appropriate access controls for both safety and security purposes. Care must be taken to prevent the inadvertent or intentional introduction of vulnerabilities. At a time when many operating plants are moving from analog to digital instrumentation and control, protection of the facility from bugs in the software or from hackers and malicious intruders requires special attention.

Maintenance, surveillance and inspections

The availability of safety and security systems must be permanently ensured. Maintenance operations as well as surveillance and inspections should be carried out on a regular basis and compensatory measures put in place whenever a safety or security capability is rendered unavailable. Again, coordination of safety and security capabilities is necessary so that compensatory measures do not undermine the necessary balance between safety and security. For example, the shutting off of electric power to an area in order to conduct maintenance should be undertaken with full awareness of the possible compromising of surveillance systems that serve security purposes and the need to introduce compensatory security measures.

It is common at many plants to undertake many maintenance and surveillance activities during refuelling. This inevitably leads to large peaks in demand for supplementary human resources, which are in general provided by external organizations. This leads to the need for additional access and control measures to ensure security.

Feedback from operating experience

Events concerning equipment failures, identified anomalies, human errors and sabotage attempts must be recorded and evaluated appropriately. The information gained from identified incidents in the nuclear power plant or in others of similar design or operation makes it possible to improve its safety or its security. It is customary and appropriate for the operator's safety personnel to share safety information widely. Such exchange of information is much more limited in the security domain and usually only involves to individuals on a need to know basis. At times a safety event may reveal a security vulnerability and, in such a case, controls on the sharing of information may be necessary.

3 The CPPNM and the INFCIRC/225 Revision 5

Physical protection against unauthorized removal of nuclear material and against the sabotage of nuclear facilities or transports has long been a matter of national and international

concern and cooperation. The international community has agreed to strengthen the Convention on the Physical Protection of Nuclear Material [12], and it has cooperated with the IAEA in establishing nuclear security guidance. The document Recommendations for the Physical Protection of Nuclear Material was first published in 1972 [9] and, after revision, these recommendations were published in 1975 in the INFCIRC series as INFCIRC/225 [10, 20].

3.1 The CPPNM

The CPPNM was signed at Vienna and at New York on 3 March 1980. In July 2005, a Diplomatic Conference was convened to amend the Convention and strengthen its provisions [13]. The purposes of this Convention are to achieve and maintain worldwide effective physical protection of nuclear material used for peaceful purposes and of nuclear facilities used for peaceful purposes; to prevent and combat offences relating to such material and facilities worldwide; as well as to facilitate co-operation among States Parties to those ends. The amendments will take

Material	Form	Category I	Category II	Category III[c]
Pu[a]	Unirradiated[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less but more than 15 g
^{235}U	Unirradiated[b]			
	U enriched to 20% ^{235}U or more	5 kg or more	Less than 5 kg but more than 1 kg	1 kg or less but more than 15 g
	U enriched to 10% ^{235}U, but less than 20%		10 kg or more	Less than 10 kg but more than 1 kg
	U enriched above natural, but less than 10%			10 kg or more
^{233}U	Unirradiated[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less but more than 15 g
Irradiated fuel			Depleted or natural U, Th or low-enriched fuel (less than 10% fossile content)[d,e]	

[a] *All plutonium except that with isotopic concentration exceeding 80% in 238 Pu.*
[b] *Material not irradiated in a reactor or material irradiated in a reactor but with a radiation level equal to or less than 1 Gy/h at one metre unshielded.*
[c] *Quantities not falling in Category III and natural uranium should be protected in accordance with prudent management practice.*
[d] *Although this level of protection is recommended, it would be open to States, upon evaluation of the specific circumstances, to assign a different category of physical protection.*
[e] *Other fuel which by virtue of its original fissile material content is classified as Category I and II before irradiation may be reduced one category level while the radiation level from the fuel exceeds 1 Gy/h at one metre unshielded.*

effect once they have been ratified by two-thirds of the States Parties of the Convention (in Figure 3.1 the current status of the CPPNM ans its Amendment is presented [24]).

Convention and its amendment shall apply to nuclear material used for peaceful purposes in use, storage and transport and to nuclear facilities used for peaceful purposes. Moreover, it is retified that each State Party shall establish, implement and maintain an appropriate physical protection regime applicable to nuclear material and nuclear facilities under its jurisdiction, with the aims of:

- protecting against theft and other unlawful taking of nuclear material in use, storage and transport;
- ensuring the implementation of rapid and comprehensive measures to locate and, where appropriate, recover missing or stolen nuclear material;
- protecting nuclear material and nuclear facilities against sabotage;
- mitigating or minimizing the radiological consequences of sabotage.

In detail, both the categorization of nuclear material (see Table 3.1) and levels of physical protection to be applied in international transport of nuclear materials are provided [12].

This categorization and, more in detail, the requirements for physical protection to be applied for each different materials can be found in the IAEA recommendations on physical protection [20].

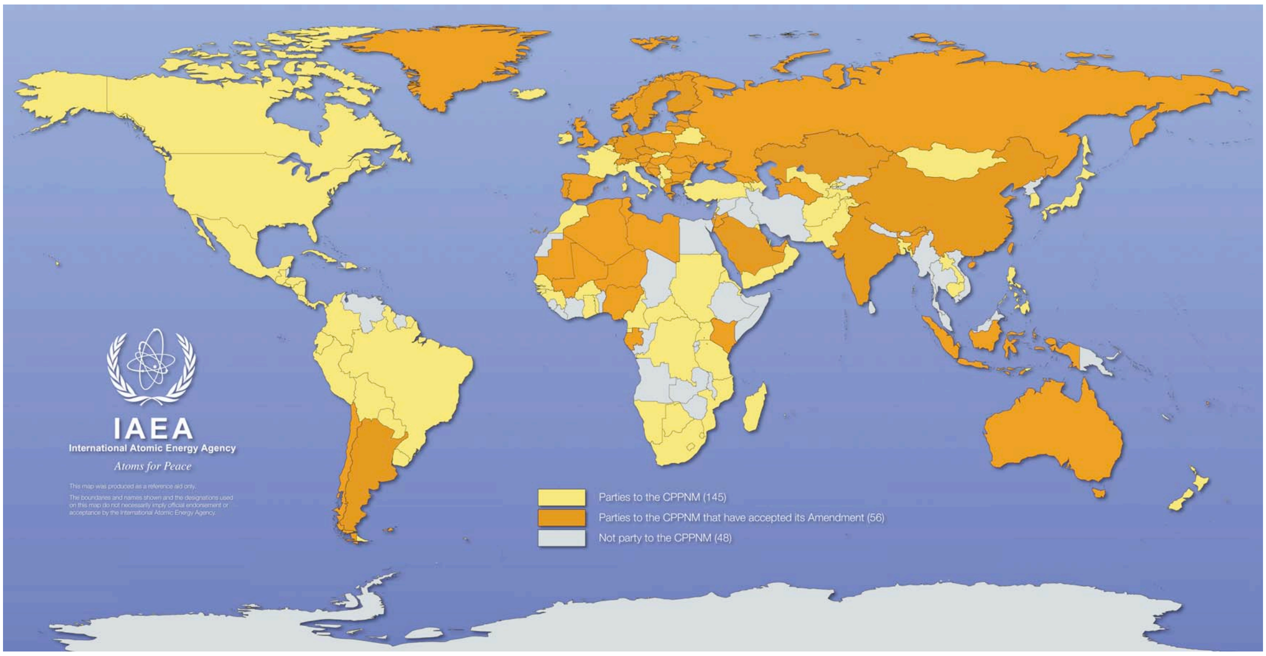


Fig. 3.1: Status of the CPPNM ans its Amendment (as of 8 May 2012).

Another important factor is that each State shall establish or designate a competent authority or authorities responsible for the implementation of the legislative and regulatory framework.

A particular attention is given to the list of intentional acts that must be punished. In particular, these are:

- act without lawful authority which constitutes the receipt, possession, use, transfer, alteration, disposal or dispersal of nuclear material and which causes or is likely to cause death or serious injury to any person or substantial damage to property or to the environment;
- a theft or robbery of nuclear material;
- a misappropriation or fraudulent obtaining of nuclear material;
- an act which constitutes the carrying, sending, or moving of nuclear material into or out of a State without lawful authority;
- an act directed against a nuclear facility, or an act interfering with the operation of a nuclear facility, where the offender intentionally causes, or where he knows that the act is likely to cause, death or serious injury to any person or substantial damage to property or to the environment by exposure to radiation or release of radioactive substances, unless the act is undertaken in conformity with the national law of the State Party in the territory of which the nuclear facility is situated;
- an act constituting a demand for nuclear material by threat or use of force or by any other form of intimidation;
- an act constituting a demand for nuclear material by threat or use of force or by any other form of intimidation.

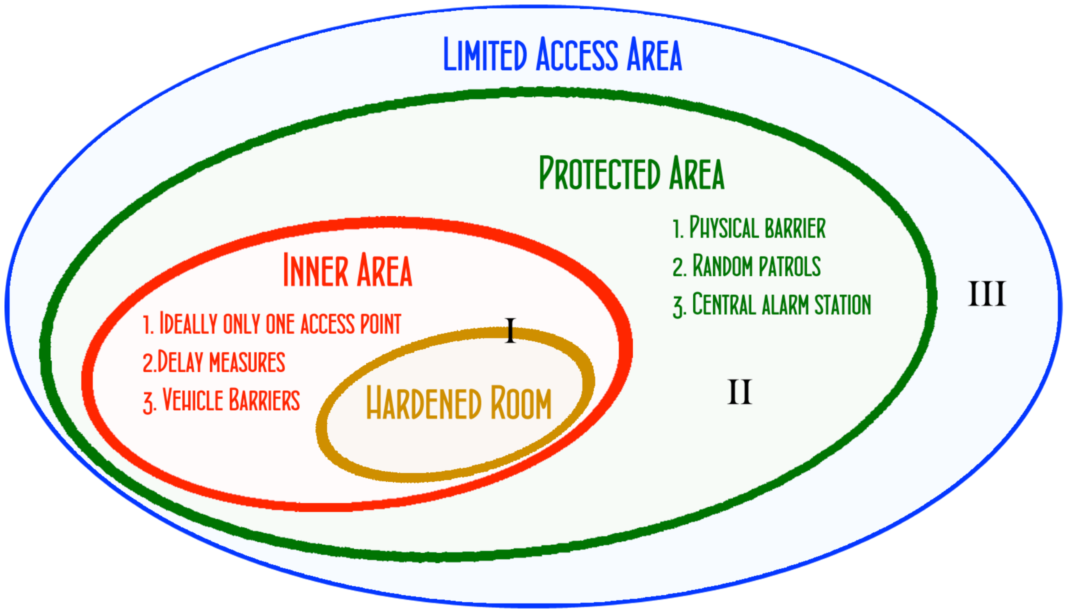
3.2 The INFCIRC/225 Rev. 5

The INFCIRC/225 provides a set of recommended requirements to achieve the Physical Protection Objectives (see below) and to apply the Fundamental Principles (see below) that were endorsed by the IAEA Board of the Governors and General Conference in September 2001 [25]. In particular, it gives recommendations on how to develop or enhance, implement and maintain a physical protection regime for nuclear material and nuclear facilities, through the establishment or improvement of their capabilities to implement legislative and regulatory programmes to address the protection of nuclear material and nuclear facilities in order to reduce the risk of malicious acts involving that material or those facilities. Three types of risk are taken into consideration for the protection of nuclear material and nuclear facilities:

- Risk of unauthorized removal with the intent to construct a nuclear explosive device;
- Risk of unauthorized removal which could lead to subsequent dispersal;
- Risk of sabotage.

Moreover, it includes also actions undertaken to locate and recover nuclear material prior to the reporting of lost, missing or stolen nuclear material to a competent authority according to national regulations.

According to the categorization of nuclear material present in the CPPNM (see Table 3.1) the requirements for each categories of nuclear material against unauthorized removal in use and storage are described in this document. The main concept can be summarized as in Figure 3.2.



The Hardened Room acts as a storage providing an additional layer of detection and delay against removal.

Fig. 3.2: Requirements for categories I, II and III nuclear material.

Objectives of a state's physical protection regime The objectives of the State's physical protection regime, which is an essential component of the State's nuclear security regime, should be:

- To protect against unauthorized removal. Protecting against theft and other unlawfultaking of nuclear material;
- To locate and recover missing nuclear material. Ensuring the implementation of rapid and comprehensive measures to locate and, where appropriate, recover missing or stolen nuclear material;
- To protect against sabotage. Protecting nuclear material and nuclear facilities against sabotage;
- To mitigate or minimize effects of sabotage. Mitigating or minimizing the radiological consequences of sabotage.

Fundamental principles for a state's physical protection regime

1. Responsibility of the State. The responsibility for the establishment, implementation and maintenance of a physical protection regime within a State rests entirely with that State.

2. *Responsibilities during International Transport*. The responsibility of a State for ensuring that nuclear material is adequately protected extends to the international transport thereof, until that responsibility is properly transferred to another State, as appropriate.
3. *Legislative and Regulatory Framework*. The State is responsible for establishing and maintaining a legislative and regulatory framework to govern physical protection. This framework should provide for the establishment of applicable physical protection requirements and include a system of evaluation and licensing or other procedures to grant authorization. This framework should include a system of inspection of nuclear facilities and transport to verify compliance with applicable requirements and conditions of the licence or other authorizing document, and to establish a means to enforce applicable requirements and conditions, including effective sanctions.
4. *Competent Authority*. The State should establish or designate a competent authority which is responsible for the implementation of the legislative and regulatory framework, and is provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities. The State should take steps to ensure an effective independence between the functions of the State's competent authority and those of any other body in charge of the promotion or utilization of nuclear energy.
5. *Responsibility of the Licence Holders*. The responsibilities for implementing the various elements of physical protection within a State should be clearly identified. The State should ensure that the prime responsibility for the implementation of physical protection of nuclear material or of nuclear facilities rests with the holders of the relevant licences or of other authorizing documents (e.g. operators or shippers).
6. *Security Culture*. All organizations involved in implementing physical protection should give due priority to the security culture, to its development and maintenance necessary to ensure its effective implementation in the entire organization.
7. *Threat*. The State's physical protection should be based on the State's current evaluation of the threat.
8. *Graded Approach*. Physical protection requirements should be based on a graded approach, taking into account the current evaluation of the threat, the relative attractiveness, the nature of the nuclear material and potential consequences associated with the unauthorized removal of nuclear material and with the sabotage against nuclear material or nuclear facilities.
9. *Defence in Depth*. The State's requirements for physical protection should reflect a concept of several layers and methods of protection (structural, other technical, personnel and organizational) that have to be overcome or circumvented by an adversary in order to achieve his objectives.
10. *Quality Assurance*. A quality assurance policy and quality assurance programmes should be established and implemented with a view to providing confidence that specified requirements for all activities important to physical protection are satisfied.

11. *Contingency Plans*. Contingency (emergency) plans to respond to unauthorized removal of nuclear material or sabotage of nuclear facilities or nuclear material, or attempts thereof, should be prepared and appropriately exercised by all licence holders and authorities concerned.
12. *Confidentiality*. The State should establish requirements for protecting the confidentiality of information, the unauthorized disclosure of which could compromise the physical protection of nuclear material and nuclear facilities.

4 The legislation in France

France has developed a large-scale nuclear program for more than 40 years. This program includes a complete nuclear fuel cycle, with most electricity produced by nuclear plants, as well as many test and research facilities. The common point between all these facilities is the use of fissile or fertile material. The integration of the risks associated with this program is part of the responsibilities of the French State with respect to its citizens, but also the international community.

This integration led France to develop a general protection policy against malevolent actions, which is part of the legal framework of the Defence code [26, 27, 28, 29] (see Figure 4.1), for both legislative and regulatory purposes. This legal framework has been revised in recent years to reinforce the protection of nuclear material and associated facilities. This regulatory renovation was completed in 2011 and aims to:

- meet international requirements (UN resolutions against nuclear terrorism [16, 15], amendment to the convention on the physical protection of nuclear material and facilities [13], changing ideas and practices in the field of nuclear security inherent to the development of the security series texts of the IAEA);
- bring closer and harmonise regulations, particularly regulations on the theft and diversion of nuclear material (nuclear proliferation) and the protection of nuclear facilities against malevolent actions (radiological consequences);
- consider the complementary nature of nuclear security and safety policies in the field of protection against acts of malice (sabotage);
- revise the Design Basis Threat (tougher threats to take into account the changing international context);
- reinforce the legal framework, particularly in view of the emergence of a growing number of private operators holding of nuclear material.

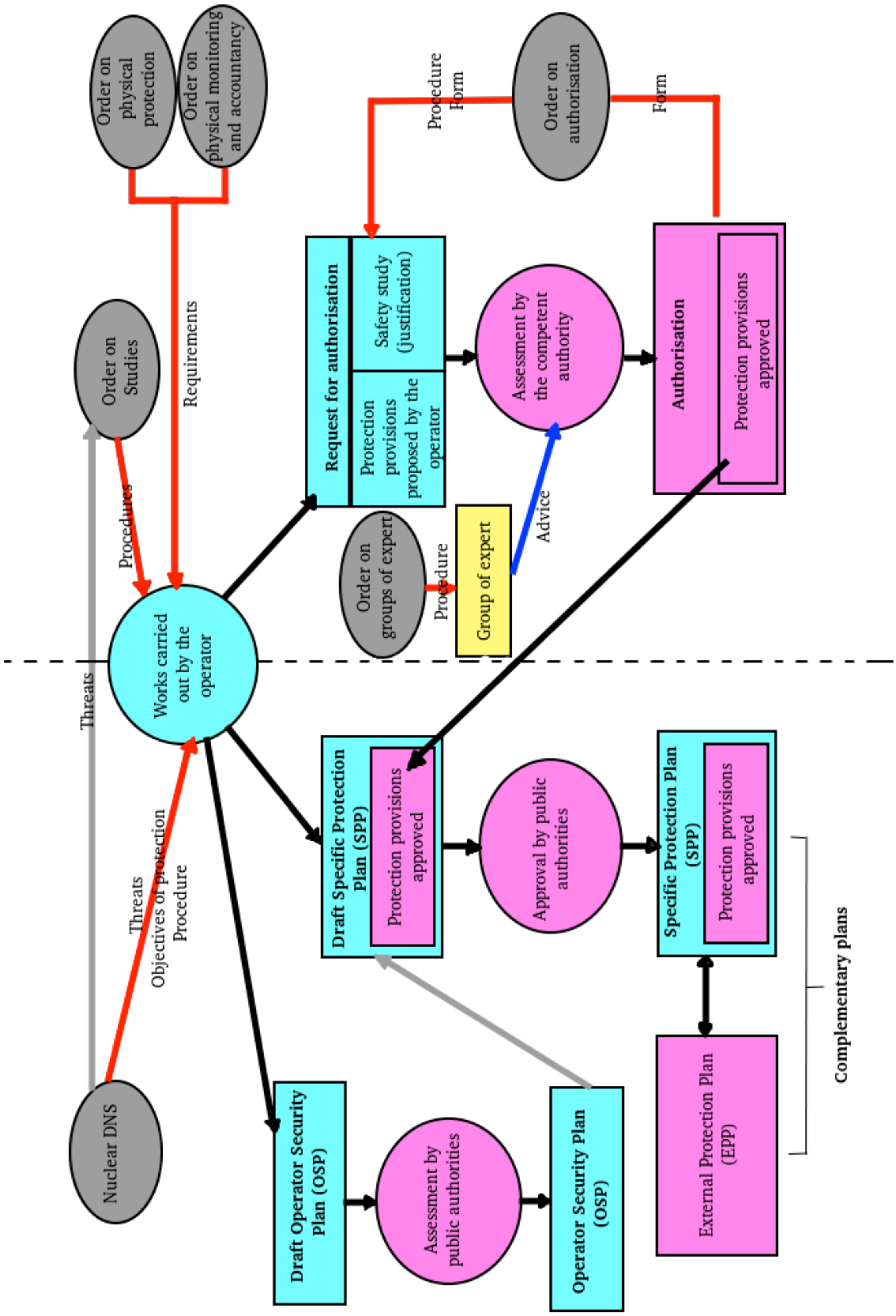


Fig. 4.1: Nuclear securty regulations in France.

4.1 State organization

Several entities within public authorities are involved in nuclear security provisions:

1. The General Secretariat of Defence and National Security (SGDSN) is a service of the Prime Minister and coordinates between the different ministers in terms of defence and security. The SGDSN is in charge of preparing and updating regulations on activities of vital importance, which includes defining the threats to be considered. The SGDSN is also responsible for defining confidentiality policy and preparing enforcement rules.
2. The Minister in charge of energy is responsible for control of nuclear material for civil use. It is backed up by a service consisting of personnel in charge of processing documents and preparing regulations. This service is subject to the responsibility of the Senior defence and security official for the Minister of ecology, sustainable development, transport and housing (HFDS), which acts as the nuclear security authority. In addition, the HFDS can use the services of a technical support body, the Institut de radioprotection et de sûreté nucléaire (IRSN).
3. The Minister of the interior, overseas, regional authorities and immigration hols authority over all local and national law enforcement agencies likely to be involved in the event of malevolent actions. Intelligence services reporting to this Minister play a key role in preventing malevolent actions and contributing to the assessment of the threat.
4. Departmental prefects manage the State activities in each departement, so they are mainly responsible for the local organisation of all crises which occur in the departement and, in particular, those caused by an accident or a malevolent action, possibly affecting a nuclear facility. This key role of the departmental prefect in the event of a crisis led to a remit to approve the Specific Protection Plan (SPP) prepared by the operator and apply the External Protection Plan (EPP) provided for in regulations on activities of vital importance.
5. The Nuclear Safety Authority (NSA) analyses, in terms of impact and consequences, the risks and drawbacks that nuclear installations could cause in terms of public health, safety and security or for the protection of nature and the environment, whatever the origin of such risks (resulting or not from malevolent action). If necessary, the NSA defines the necessary provisions for the protection of these interests. In the event of an emergency radiological situation, of whatever origin, the NSA acts in a consultative role with regard to the French public authorities (in particular the Prefect, the Minister in charge of managing the crisis and the Prime Minister), especially with respect to protecting the population and the environment. The NSA also has the mission of ensuring that the operator takes the necessary measures to render its installation safe in the event of it being the victim of a malevolent action.

4.2 The Nuclear Safety Authority

The NSA is made up of a college of five members appointed by decree on account of their competence in the field of nuclear safety and radiation protection. In Figure 4.2 a scheme of the NSA organization is presented. Three of the members, including the chairman, are appointed by the President of the Republic. The two other members are appointed respectively by the President of the National Assembly and the President of the Senate. The mandate of the members is for six years. Nobody can be appointed to the college after age sixty-five. The mandate of the members is not renewable. The duties of a member cannot be terminated except in the event of an impediment or resignation recorded by the NSA acting by a majority of the members of its college. However, the President of the Republic can also terminate the duties of a member of the college in the event of a serious failure to comply with his obligations.

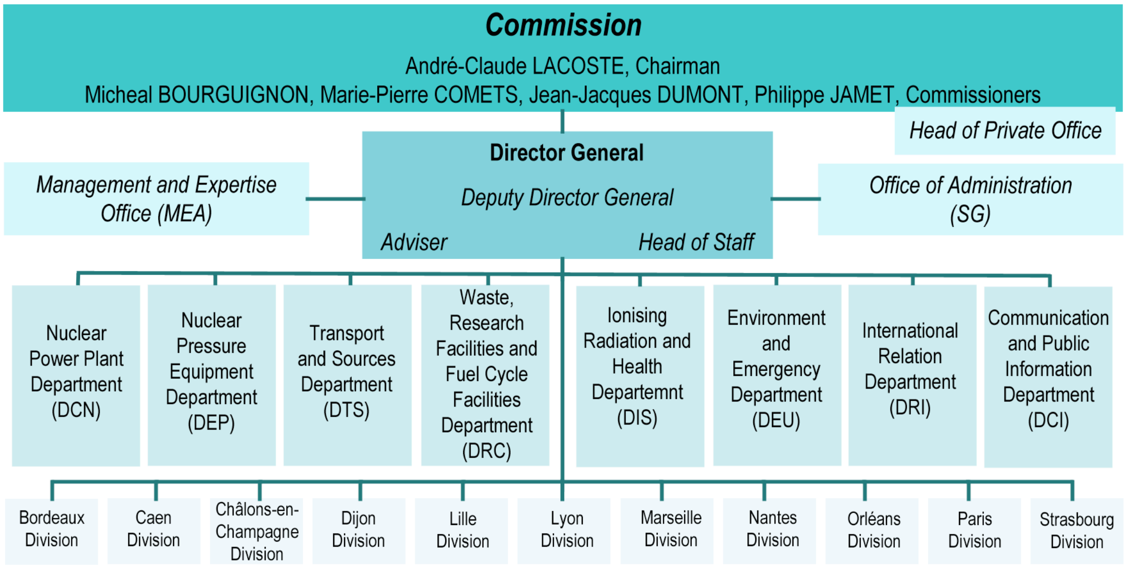


Fig. 4.2: French NSA organization.

The members of the college of the Nuclear Safety Authority exercise their duties full time. The chairman and members of the college receive respectively a salary equal to that paid to the first and second of the two higher categories of State employment classified outside the pay scale. The members of the college exercise their duties entirely impartially without receiving any instructions from the Government or from another other person or institution. The post of member of the college is incompatible with any professional activity, any elective mandate and any other public employment. The NSA records, by a majority of the members composing the college, the automatic resignation of any member who finds himself in one of these cases of incompatibility.

The NSA, as an independent administrative authority, participates in the surveillance of nuclear safety and radiation protection and in informing the public in these fields. In this respect, the NSA is consulted on draft decrees and draft ministerial orders of a regulatory nature relating to nuclear safety. It can take regulatory decisions of a technical nature to complete the implementing procedures for decrees and orders adopted in the nuclear safety or radiation protection field, except for those relating to occupational medicine. These decisions are subject to the approval of the ministers. Besides these activitie, the NSA takes part in the management of radiological emergency situations resulting from events likely to endanger personal health and the environment by exposure to ionising radiations and occurring in France or likely to affect the French territory. Not only it contributes with its technical assistance to the competent authorities in elaborating, as part of the emergency response plans, arrangements but when such an emergency situation occurs, it assists the Government for all matters within its competence. It sends the competent authorities its recommendations on the measures to be taken at the medical and health levels or regarding civil security. It informs the public of the safety state of the installation that caused the emergency situation, when the latter is subject to its surveillance, and of the possible releases into the environment and their risks for personal health and the environment [30].

4.3 Physical protection of facilities

In France there are different legislations according to the protection of facilities of vital importance [26, 28] and the physical protection of facilities housing nuclear materials [31].

The first important thing is the definition of area of vital importance: an area of activity of vital importance is constituted of activities contributing to a same objective, which:

1. Concern the production and the distribution of indispensable goods or services:
   a) to satisfy needs essential for the life of populations;
   b) or to the exercise of the authority of the State;
   c) or to the running of the economy;
   d) or to maintaining the defence potential;
   e) or to national security;

   From the moment that these activities become difficult to substitute or replace;
2. Or may pose a serious danger for the population.

The Coordinating Minister for an area of activity of vital importance conducts the risk analysis of this sector, while taking into account the threat scenarios. The results of the risk analysis are subject to the opinion of the commission for the defence and security of areas of activity of vital importance, with the exception of results involving areas of activity of vital importance for which the Minister of Defence is the coordinator. The national security directive(s) are based on the risk analysis and they apply to an area of activity of vital importance and detail the objectives and the security policies of the area. They define planned and graduated measures for vigilance, prevention, protection and reaction against any threat, particularly of a terrorist nature. For the application of these measures, the Prime Minister, after opinion of the commission, sets out by orders:

1. The analysis and risk management method;
2. The method to follow so as to determine, by area of activity of vital importance, the threat scenarios and their classification by order of importance depending on the envisaged type or level of threat;
3. The model plans for the security plans of operators of vital importance (Operator Security Plan, OSP), specific protection plans (SPP) and external protection plans (EPP). They are notified to each operator of vital importance concerned and to all the administrative authorities that need to be informed thereof.

Regarding these securty plans, the operator of vital importance which manages or uses more than one establishment, facility or installation drafts the OSP. The purpose of OSP is to define the general policy for protecting all of these establishments, facilities or installations, particularly those organised into networks. on the basis of this plans, the operator of vital importance must present the SPP of each point of vital importance to the prefect of the department under whose jurisdiction the point is located. The SPP comprises permanent protection measures and temporary and graduated measures. For each point of vital importance provided with the SPP, the Departmental Prefect draws up, in consultation with the delegate of the operator of vital importance for defence and security of this point, a EPP. The EPP, which details the planned measures of vigilance, prevention, protection and reaction provided by the public authorities, is protected under the conditions of national defence secrecy.

For the physical protection of facilities containing nuclear materials, it is considered as “physical protection system" (PPS) all devices and procedures deployed by the holder of the authorization to protect targets against malevolent action likely to lead to the theft or diversion of materials or to radiological consequences. This system includes active and passive means of prevention, delaying, detection, warning, follow-up of intruders and intervention.

In respect of the concept of defense-in-depth, several protection lines can be implemented:

- a zone with controlled access;
- a zone with normal protection;
- a zone with reinforced protection;
- an internal zone;
- a vital zone;
- a storage area known as a "store".

These different area request different PPS: a zone with normal protection or reinforced protection is included in a zone with controlled access; an internal or vital zone is located in a zone with reinforced protection; a store is contained in an internal zone. Each zone is marked out by a physical barrier separate to the barriers around the other zones, unless special provisions are mentioned in appendix to this order. This physical barrier has a limited number of openings and access points. Special penetration in a zone, particularly buried penetration, openings and, when closed, access points to a zone, are equipped with devices providing protection equivalent to the devices in the zone in question. Access points are supervised directly and at all times when open. In addition, emergency exits are equipped with opening and presence detectors. All the PPS can be divided into measure for Prevention & Delaying, Detection and Alert & Intervention. In the Order of 10 June 2011 [31], a detail description of the misure applicable to each zone is presented, while a summary is represent in Figure 4.3.

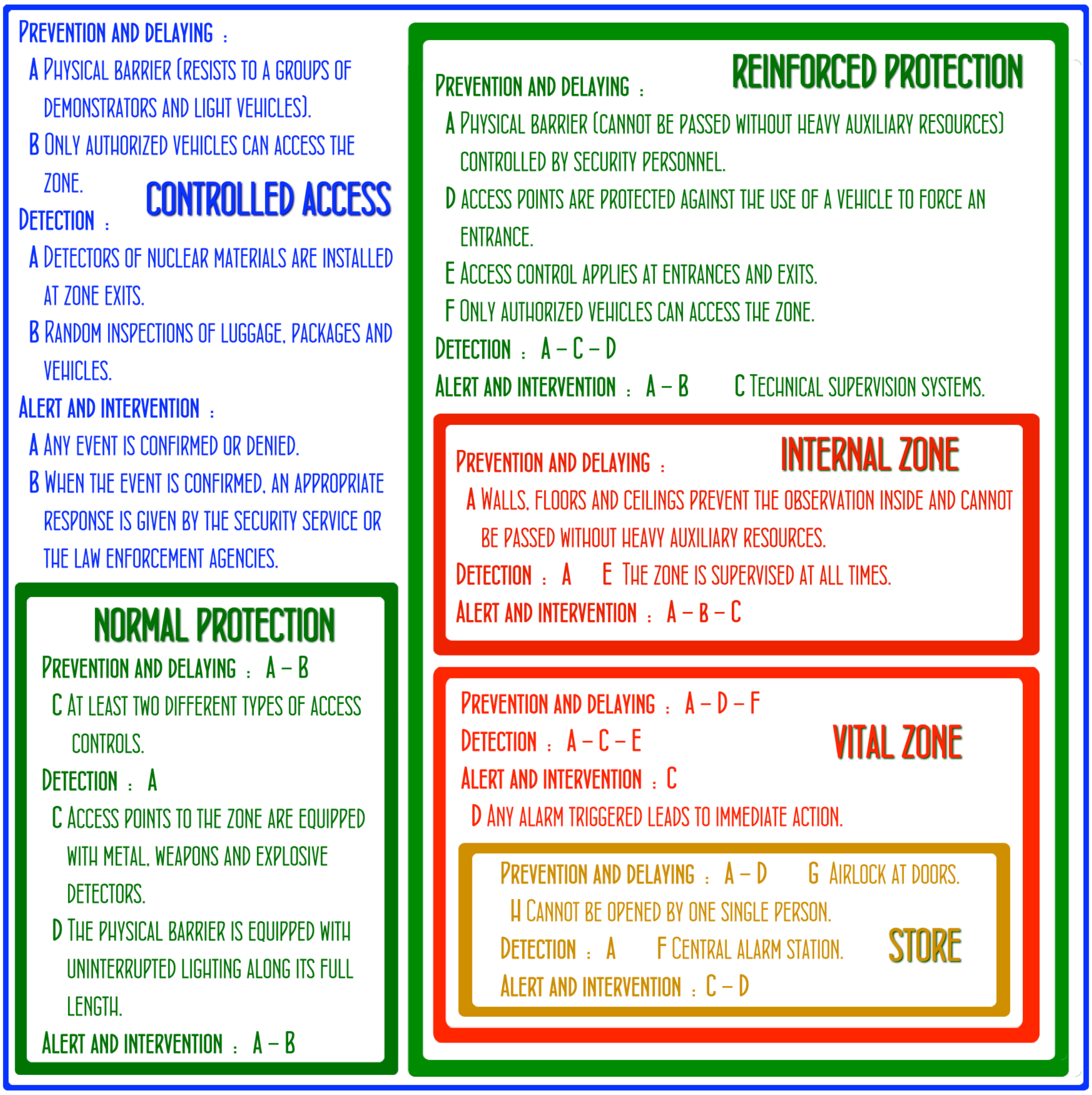


Fig. 4.3: Physical Protection System in France.

4.4 Physical protection & Accountancy of nuclear material

For the purpose of their protection against loss, theft and diversion, nuclear materials are classified, according to their nature and quantity, into three categories (I, II and III) as defined in Table 3.1 for Pu, 235U and 233U and in Table 4.1 for other materials [27, 29].

The nuclear materials assigned to category I are used within an internal zone. They are stored in a store. However, the category I nuclear materials contained in power reactor fuel assemblies may be stored immerged in a pool in an internal zone. Category II nuclear materials are held inside a zone with normal protection. Category III nuclear materials are protected with a zone with controlled access. In addition, access to these nuclear materials is technically prohibited to unauthorized individuals and handling devices. The corresponding protective devices are described in the authorization. No nuclear material, regardless of its category, is stored in a

Material	Form	Category I	Category II	Category III[c]
^{3}H	Unirradiated[b]	—	—	More than 2 g
Natural Uranium: uranium depleted in the isotope ^{235}U	Unirradiated[b]	—	—	500 kg or more
Th				
Lithium enriched in ^{6}Li				1 kg or more of contained ^{6}Li
Irradiated fuels	Irradiated[d]		All fuels	
Dispersed and weakly concentrated materials	Objects with an average fissile matter content of less than or equal to 0.1% by mass[e]	—	—	3 g or more (Pu and ^{233}U) 15 g or more (^{235}U)

[b] Nuclear materials not irradiated in a reactor or material irradiated in a reactor yielding an absorbed dose rate in air below or equal to but with a radiation level equal to or less than 1 Gy/h at one metre unshielded.
[d] Nuclear materials irradiated in a reactor yielding an absorbed dose rate in air in excess of 1 Gy/h at one metre unshielded.
[e] Nuclear materials that are dispersed within objects (alloys, waste packages, etc.) and whose mass content is expressed as the total mass of nuclear materials over the net mass of the object.

In the case of a mixture of materials, the threshold T for affiliation with category I, II or III is determined by means of the formula $1/T = \sum (f_i/T_i)$ where f_i represents the mass fraction of material i in the mixture and T_i represents the threshold associated with material i as defined in the above table.

Tab. 4.1: Categorization of Nuclear Material.

transport vehicle beyond the duration necessary for loading and unloading operations. The authorization defines the conditions for the protection of these operations [31].

The accountancy of nuclear material, consist of a system of tracking, measuring, and accounting for nuclear material to deter or detect theft or loss. The equipment and procedures for assuring physical monitoring, physical protection and accountancy are dissociated. Moreover, persons with the responsibility or missions relating to physical monitoring of nuclear materials are not authorised to be involved in the accountancy of nuclear materials or measures for physical protection [32]. Establishments and installations are divided into one or more accountancy zones: this division provides that a physical monitoring zone is not covered by several accountancy zones (for “accountancy zone” is mean a part of the establishment or installation subject to authorisation that may contain nuclear materials and in which any operation affecting the inventory of materials held is registered in the operator's accountancy). When a physical monitoring zone contains only nuclear materials in the form of identified articles, it is possible to derogate from this measure to take into account limitations from the application of international agreements on the verification of nuclear materials. In this case, the physical monitoring zone is entirely contained in the different accountancy zones that cover it and assignment of articles to these accountancy zones is registered in the physical monitoring system and subject to the traceability measures.

In France, the accountancy (in gram) is kept by accountancy zone for each of the following materials:

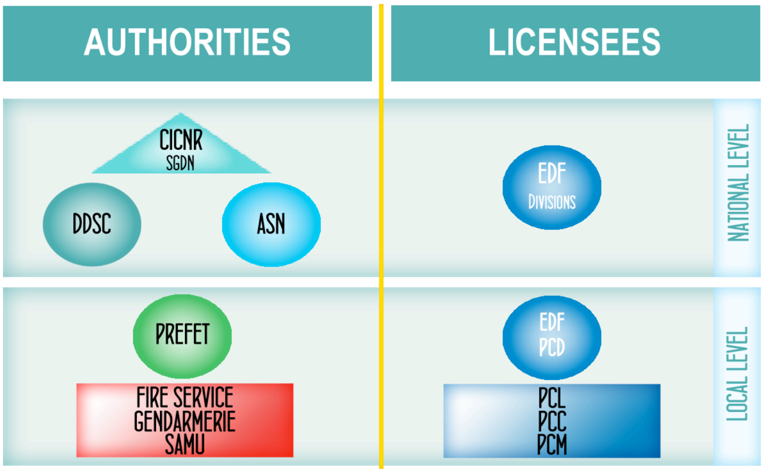
1. thorium, except for alloys containing less than 5% thorium by mass;
2. depleted uranium;
3. natural uranium;
4. uranium enriched to less than 10 percent in uranium-235;
5. uranium enriched to 10% or more, but less than 20% in uranium-235;
6. uranium enriched to 20 percent or more in uranium-235;
7. uranium-233;
8. plutonium;
9. deuterium in the form of a gas, as hydride or heavy water;
10. concentrated tritium;
11. lithium enriched with lithium-6.

The accountancy distinguishes also nuclear materials intended for defence purposes andthose intended for any other use.

Every variations affecting the inventory are registered: chronological registration in a log book of each of the changes, as movements outside the accountancy zone, arrivals and departures or internal operations, affecting the quantity of the inventory of nuclear materials in an accountancy zone or its distribution. Variations in inventory are registered the same day they are observed using documents to ensure tracing and submitted by those in charge of physical monitoring. Accountancy will provide current accountancy inventory immediately upon request.

4.5 Emergency and contingency plans

Application of the principle of defence in depth entails the inclusion of severe accidents with a very low probability of occurrence when drafting the emergency plans, in order to determine the actions necessary to protect plant personnel and the population and to control the accident. The response organisation of the authorities and that of the licensee are presented in Figure 4.4.



CICNR: International committee on nuclear or radiological emergencies
SGDN: General secretariat for national defence
DDSC: Directorate for defence and civil security
PCD: Management command post
PCL: Local command post
PCC: Supervision command post
PCM: Resources command post

Fig. 4.4: French emergency organisation in accident at an EDF nuclear reactor.

In France, two different emergency plans are present: the on-site and the off-site. These plans differ each other both in the managing and aims. The on-site emergency plan (PUI), prepared by the licensee, is aimed at bringing the plant back to a safe condition and mitigating accident consequences. It defines the organisational arrangements and the resources to be implemented on the site. It also comprises arrangements for informing the public authorities rapidly. It means that the licensee of the affected nuclear installation, implements the organisational provisions and the means needed to bring the accident under control, to assess and mitigate its consequences, to protect persons on the site and alert and regularly inform the authorities.

The off-site emergency plan (PPI or ORSEC), instead, drafted by the préfet, is aimed to protect populations in the short term in the event of an accident and provide the licensee or the party in charge of transport with outside intervention assistance. It specifies the initial actions to take to protect the population, the roles of the various services concerned, the systems for giving the alert, and the human and material resources likely to be engaged. In this case, the préfet of the département in which the installation is located, takes the necessary decisions to protect the population, the environment and the property threatened by the accident. He is thus responsible for coordinating the resources, both public and private, human and material, deployed in the plan. He keeps the population and the mayors informed of events. Moreover, PPIs identify the population protection actions to limit the consequences of an accident [33, 34, 35, 36]. The action levels are defined by ASN decision 2009-DC-0153 of 18 August 2009 [37]:

- an effective dose of 10 mSv for sheltering;
- an effective dose of 50 mSv for evacuation;
- an equivalent dose to the thyoroid of 50mSv for the administration of stable iodine.

For example, the PPIs defined for the vicinity of a PWR reactor stipulate sheltering of the population and the absorption of stable iodine within a 10km radius, plus evacuation of the population within a 5 km radius. In detail:

- sheltering and listening: the individuals concerned, alerted by a siren, take shelter at home or in a building, with all openings carefully closed, and wait for instructions from the préfet broadcast by radio;
- administration of stable iodine tablets: when ordered by the préfet, the individuals liable to be exposed to releases of radioactive iodine are urged take the prescribed dose of potassium iodide tablets;
- evacuation: in the event of an imminent risk of large-scale radioactive releases, the préfet may order evacuation. The populations concerned are asked to prepare a bag of essential personal effects, secure and leave their homes and go to the nearest muster point.

In the event of effective release of radioactive substances into the environment, these three actions also include the first action that should be decided on exit from the emergency phase to prepare for management of the post-accident phase (see Figure 4.5). The region would then be zoned with [36]:

- a Population Protection Zone (PPZ) within which contamination reduction actions will be rapidly undertaken;
- a Tightened Surveillance Zone (TSZ) within which the consumption and sale of foodstuffs produced will initially be prohibited, and subsequently subject to a conditional release inspection based on the maximum permissible radioactivity levels set by the European Commission;
- if necessary, a population clearing zone within the PPZ if external exposure levels due to deposits justify it.

Furthermore, since 1987, actions to control urban development around non-nuclear industrial facilities has been deployed, but these actions have been reinforced since the AZF accident[5] of 2001. The broad principles of urban development control are:

- preserve the operability of the off-site emergency plans;
- favour urban development outside the risk zone;
- allow controlled development that meets the needs of the resident population.

[5] On 21 September 2001 a fertiliser factory containing ammonium nitrate storage facilities exploded. The factory was located 3 km from the centre of Toulouse on an island of the Garonne River surrounded by an urban environment: 22 people were killed on the factory site and 8 persons outside; in total 2500 persons were injured.

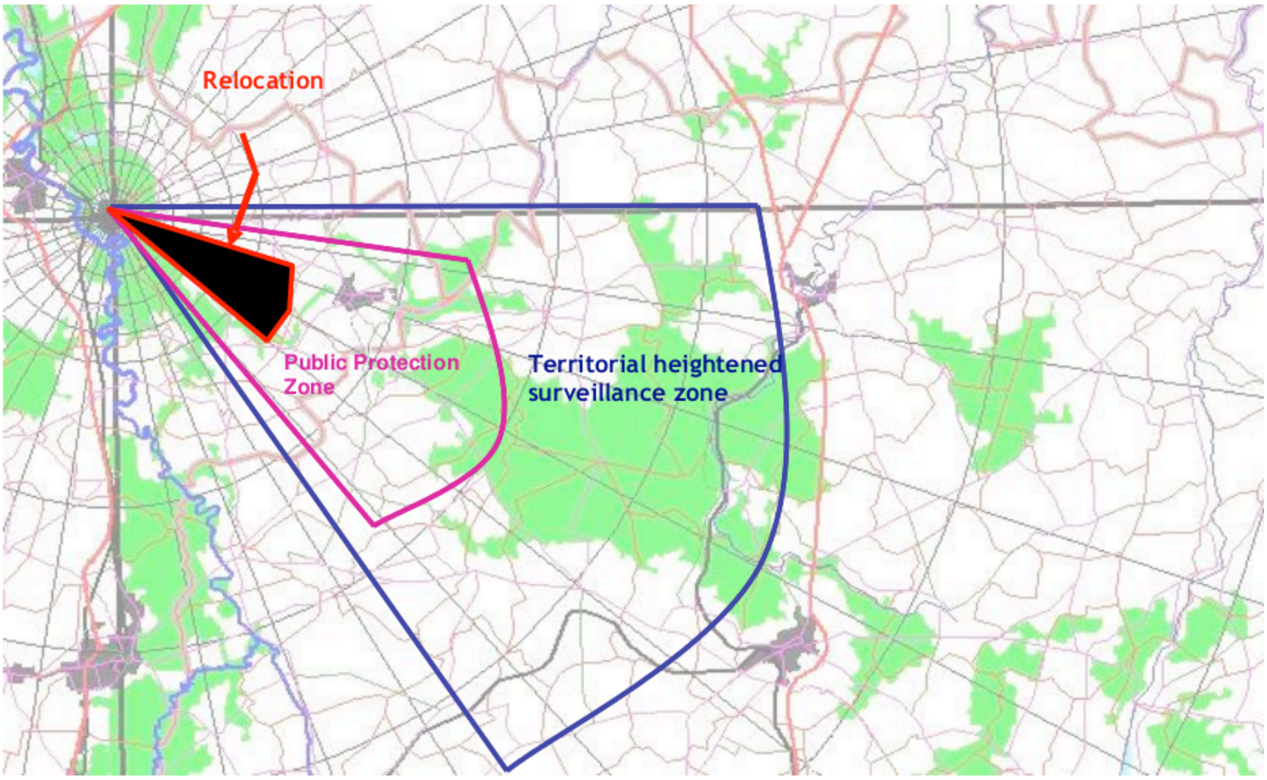


Fig. 4.5: Schematic representation of post-accident zoning.

From the security point of view, instead, the SGDSN analyses risks and plans prevention and operating provisions to counteract terrorist threats and monitors the application of these provisions. One key element of this approach is the "Vigipirate" plan, a government vigilance, prevention and protection plan. Designed in 1978, the plan was revised after the attacks of 11 September 2001, in order to improve the State's ability to manage potential threats to the population, activities of vital importance and the continuity of the life of the nation. The "Vigipirate" plan has two objectives: protect the population, infrastructures and institutions, and prepare responses in the event of an attack. The most recent version of the plan is based on the assumption that the terrorist threat must now be considered as permanent. It defines set of basic operational provisions applied in all circumstances, even in the absence of precise signs of threats.

Crime	Penalties
Attempt on the safety of nuclear installations or facilities, sites or facilities used for the production, storage or transport of nuclear material, if it will be resulting in risk for public safety.	10 years' imprisonment. Fine of 7.5 *million* €.
Purchase, receipt, possession, sale to third parties, use, transportation, importation, exportation, processing, disposal or dispersal of nuclear material capable of causing death or personal injury to one or more persons or significant damage to property or to environment.	10 years' imprisonment. Fine of 7.5 million €. Organized gang: 15 years' imprisonment. Fine of 7.5 million €. If committed with a view to enabling anyone acquire a nuclear weapon: 20 (30 for organized gang) years' imprisonment. Fine of 7.5 million €.
Hindering the exercise of control pursuant to import and export of nuclear material or providing inaccurate information to the agents responsible for this.	2 years' imprisonment. Fine of 30 000 €. Organized gang: 10 years' imprisonment. Fine of 150 000 €.
Failed to inform the police or gendarmerie services within no more than 24 hours following the ascertainment of the loss, theft, disappearance or diversion of nuclear materials.	2 years' imprisonment. Fine of 37 500 €.
Exporting without authorization related products to the nuclear materials contained in the list defined by a joint decree of the ministry of defense and ministry in charge of industry; Unduly obtaining by any fraudulent means the authorization to export these same products.	5 years' imprisonment. Fine of 75 000 €. Organized gang: 10 years' imprisonment. Fine of 150 000 €. If committed with a view to enabling anyone acquire a nuclear weapon: 20 (30 for organized gang) years' imprisonment. Fine of 7.5 million €.
Start up a NPP without authorization.	3 years' imprisonment. Fine of 150 000 €.
Transporting radioactive substances without authorization.	1 years' imprisonment. Fine of 30 000 €.

The period of imprisonment applicable to the offender or accomplice in relation to the offences provided, shall be reduced by half if, after informing the administrative or judicial authority, he has helped to stop the illegal acts or to prevent the offence from resulting in loss of human life or permanent disability, and to identify, where applicable, other offenders or accomplices.

Tab. 4.2: Penalties in France.

4.6 Penalties

Inside the French Defence Code [26, 28, 30], all the possibilities of offences and penalities are described. In particular, they are to apply to the fusible, fissile or fertile nuclear materials, as well as any material, other than ores, containing one or more fusible, fissile or fertile materials. In Table 4.2 a summary of these sanctions is shown.

In addition to penalties show in Table 4.2, any individuals found guilty of any of these offences will be:

- deprived of civic, civil and family rights;
- forbidden to hold a public function or to exercise the professional or social activity in the context of which the offence has been committed;
- liable to permanent closure or closure for 5 years at most of the establishments or of one or more establishments of the company that helped to commit the offences;
- excluded from public procurement contracts for a maximum of five years;
- liable to the confiscation of the nuclear materials as well as the equipment used to prepare, use or transport these materials;
- banned from residing in France;
- barred from the French territory, if the offenders are foreigners, either definitely or for a period of ten years maximum.

5 The Italian situation: comparison with French legislation

After the sign of the CPPNM in 1980, Italy is endowed with its own system to meet the CPPNM obligations with the law of August 7th 1982 number 704 [38]. Due to the fact that this law only rafities the CPPNM, the then-Ministry of Industry, Trade and Industry (now Ministry of Economic Development - MSE) took the initiative to establish, with the Decree of 10th 1979, an Interministerial Committee for the physical protection of nuclear materials during their use. It was composed by representatives of competent State departments, which had the task of guiding, inquiring and verifying the passive physical protection plans prepared by the operators. The supervisory actions on passive physical protection have been undertaken, over these years, by the nuclear department of ISPRA (actually acting as the Italian NSA - see Section 5.2). Nowadays, to ratify the Amendment to the CPPNM, the bill number 2942 [39, 40] is under discussion and approvation of Italian Senate. It was first presented on October 5th 2011 and the last modification was applied on May 8th 2012 (the list of activities can be consulted at the Italian Senate website [41]).

5.1 State organization

Following the last version of the bill number 2942, the proposed organization inside the Italian state consist of:

1. The Ministry of Foreign Affairs (MAE) for all matters referred to collaboration and cooperation with other states in case of sabotage or theft, and for communication of relevant contact points, through international channels provided.
2. The Ministry of Interior (MI), as the competent Authority for both the active physical protection of nuclear facilities and nuclear material also during transport and for the collaboration with the MAE. Moreover, the MI is the competent authority for the description of the Design Basis Threat (DBT).
3. The Ministry of Environment (MATTM), as competent authority for the physical protection of passive materials and nuclear facilities, with the Ministry of Economic Development (MSE).
4. ISPRA (acting now, temporary, as NSA) may provide technical support to all these authorities (see Section 5.2).

5.2 The Nuclear Safety Authority

The situation in Italy about the Italian NSA is changed during the last few years and, with the decree n. 201 of Dicember 6th it is now abolished. All the activities and responsabilities that must be covered by the NSA are actually performed by ISPRA, even if this is only a temporary duty, as it is espressely said in the decree, the original italian text is following

13. Gli enti di cui all'allegato A sono soppressi a decorrere dalla data di entrata in vigore del presente decreto e i relativi organi decadono, fatti salvi gli adempimenti di cui al comma 15.

14. Le funzioni attribuite agli enti di cui al comma 13 dalla normativa vigente e le inerenti risorse finanziarie e strumentali compresi i relativi rapporti giuridici attivi e passivi, sono trasferiti, senza che sia esperita alcuna procedura di liquidazione, neppure giudiziale, alle amministrazioni corrispondentemente indicate nel medesimo allegato A.

15. Con decreti non regolamentari del Ministro interessato, di concerto con il Ministro dell'economia e delle finanze e con il Ministro per la pubblica amministrazione e la semplificazione da adottare entro novanta giorni dalla data di entrata in vigore del presente decreto, sono trasferite le risorse strumentali e finanziarie degli enti soppressi. Fino all'adozione dei predetti decreti, per garantire la continuità dei rapporti già in capo all'ente soppresso, l'amministrazione incorporante può delegare uno o più dirigenti per lo svolgimento delle attività di ordinaria amministrazione, ivi comprese le operazioni di pagamento e riscossione a valere sui conti correnti già intestati all'ente soppresso che rimangono aperti fino alla data di emanazione dei decreti medesimi.

ALLEGATO A

Ente soppresso	Amministrazione interessata	Ente incorporante
Agenzia per la sicurezza nucleare	Ministero dello sviluppo economico	Ministero dello sviluppo economico, di concerto con il Ministero dell'ambiente e della tutela del territorio e del mare

20-bis. Con riguardo all'Agenzia per la sicurezza nucleare, in via transitoria e fino all'adozione, di concerto anche con il Ministro dell'ambiente e della tutela del territorio e del mare, del decreto di cui al comma 15 e alla contestuale definizione di un assetto organizzativo rispettoso delle garanzie di indipendenza previste dall'Unione europea, le funzioni e i compiti facenti capo all'ente soppresso sono attribuiti all'Istituto superiore per la protezione e la ricerca ambientale (ISPRA).

According to the law n. 99 of July 23th 2009 and following modification with the decree n. 34 of March 31th 2011 [42, 43], the NSA should have been formed by four members and the president. Each member should be appointed by the Italian Republic President following suggestions from the President of the Council of Ministers, while the NSA president should be denominated by the

President of the Council of Ministers. They would be able to remain in charge for seven years. As in France, the members of the college of the Nuclear Safety Authority should exercise their duties full time and entirely impartially without receiving any instructions from the Government or from another other person or institution. The post of member of the college should be incompatible with any professional activity, any elective mandate and any other public employment.

The NSA should be the national body for the technical regolamentation, the control and the authorization for the safety of radioactive waste and nuclear materials originating from medical and industrial activities. Moreover, as the French NSA, it should participate in the surveillance of nuclear safety and radiation protection. The NSA should be consulted on draft decrees and draft ministerial orders of a regulatory nature relating to nuclear safety. It would be able to take regulatory decisions of a technical nature to complete the implementing procedures for decrees and orders adopted in the nuclear safety or radiation protection field.

5.3 Physical protection & Accountancy of nuclear material

For Italy, differently form France, even if the requisite for physical protection are not yet present, but they will be established by the MATTM and the MI within 6 months from the approvation of the bill number 2942, some important definitions in this field are present. In particular, the distinction between active and passive physical protection is clarified: the active one represents all the police actions to prevent or counter both fraudolent obtaining of nuclear material and sabotage of nuclear facilities; the passive one, instead, hems in all the structures, systems and procedures to surveillance nuclear facilities and protect nuclear material from both misappropriation and sabotage. For accountancy, instead, the legislation is present and it takes count not only of the nuclear material [44], but also of the radioactive materials [45, 46]. Regarding nuclear materials, each holder of fissile materials, raw and mineral, must send to the MSE and to the NSA a notification of detenction, even if there are some exception (ex. metal or miner with less than 10 kg of natural uranium or thorium, finished products with thorium...[47]), but everybody must take accountancy of these materials. Moreover, in case of reactor with a production or a consumption of fissile materials more than 1 g/y a detailed report of these activities must be product. As for France, every variations, operations and movement affecting the inventory must be registered with all details.

5.4 Emergency and contingency plans

In Italy, the nuclear crisis refer to incidental events that give rise or may give rise to a release of radioactivity into the environment and are carried out in facilities outside the national territory, in the nuclear-powered ships inside port areas, during transport of radioactive materials or that have not previously been correlated with any specific area of the country.

Different plans are described in the law: the on-site and off-site emergency plan (PEE) and the national emergency plan (PNE). Emergency planning at nuclear installations is regulated in Italy by the provisions of the Legislative Decree 230-1995 [49] and subsequent amendments. In addition, the general legislation governing emergency preparedness and response provisions in all cases of accidental events and disasters, as reported in the Act 225-1992, is applicable.

With regard to on-site emergency planning above provisions are complemented with those reported in Articles 47 and 49 of the Legislative Decree 230-1995 [49] respectively related to the Manual for the Conduct of Plant Operation and to the role of the Plant safety Committee which include, among other duties, the preparation of the on-site emergency plan. Technical Specifications attached to the license regulate the performance of periodic emergency drills. As a normal practice these drills are attended also by representatives of the regulatory authority.

As far as off-site emergency preparedness response concerns its organization differs depending on extension and type of the consequences of the postulated events (namely events which could affect a local area or a larger part of the national territory). If the potential consequences of postulated reference events result to be manageable at local level, the PEE [50], like the french PPI, is prepared by the prefect and is a civil protection plan that organizes, in accordance with other local governments public or private, the resources available to reduce or mitigate the effects of an industrial accident on areas outside the plant perimeter. The main task of the PEE is the identification of areas at risk. For each of these zones, the PEE sets the different response of civil protection.

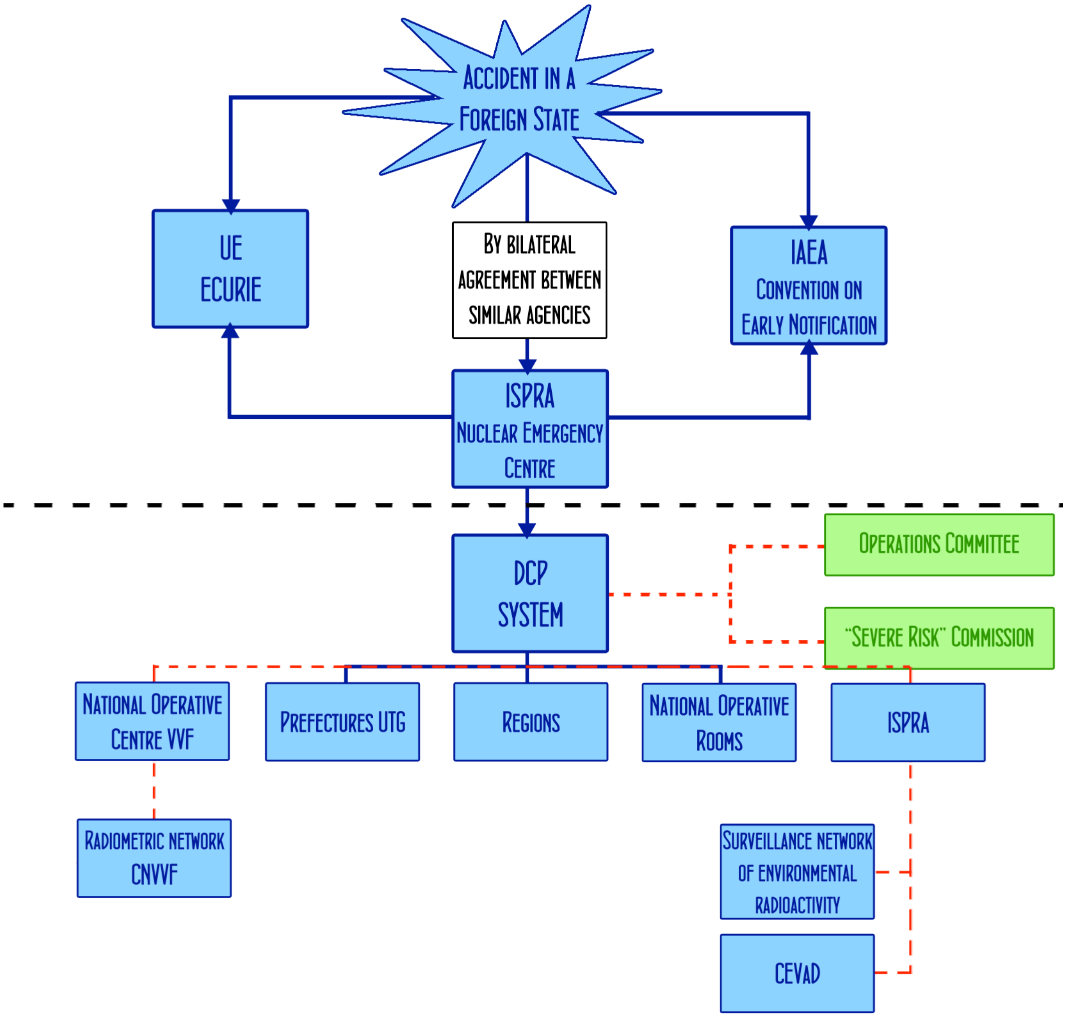
Accordling to the different effects that may occur in these areas, they will be classified as follow:

- area of maximum exposure (or high impact) that represents the area immediately adjacent to the plant and is generally characterized by serious and irreversible healthy effects. In this area the protection actions to be planned consists, generally, in sheltering indoors, even if, in some special cases, the evacuation can be planned.
- area of damage that represents an area where the consequences of the accident are still serious, especially for particular categories of people, as children, elderly, sick, pregnant women. In this area, due to the bigger extent and the low level of dangerous, the only protection action is the sheltering indoors.
- area of attention that is the outermost zone to the accident and is characterized by effects generally not serious.

Differently from the French case, the dose level (in mSv) for the different actions are espress as [48]:

- from some units to some decine of effective dose for sheltering indoors;
- from some decine to some hundreds of effective dose for evacuation;
- from some decine to some hundreds of equivalent dose for the administration of stable iodine.

The PNE [51, 48] identifies and control the measures to cope with the consequences of accidents that occur in nuclear power plants located outside the national territory (the NPP in Krško, Slovenia, and the NPP in St. Alban, France), which require response actions coordinated at national level. The plan defines the operational procedures for managing the flow of information between the various parties involved (see Figure 5.1), the activation and coordination of key components of the National Service of Civil Protection. Moreover, the PNE describes the organizational model for emergency management with an indication of priority interventions to be placed at the national level for the purpose of minimizing the effects induced by the radiological emergency on the Italian population and environment.



Blu box are for both Alert phase and Alarm one, while the green box are only in case of Allarm phase.

Fig. 5.1 : Italian emergency organisation in Alert and Alarm phase.

For the pianification of the PNE, also the threshold values espress in Table 5.1 are to take into account.

Organ or Tissue	Dose level [Gy]
Lung	6
Skin	3
Thyroid	5
Crystalline lens	2
Gonad	3
Fetus	0.1

Tab. 5.1 : Dose threshold levels for a period less than 2 days [48, 49].

5.5 Penalties

The bill number 2942 [39] and its modifications [40] will add, to the Italian penal code, all the sanctions and penalties coming not only from the non conformity with the laws, but also from malevolent act against nuclear materials and facilities. In Table 5.2 a summary of these sanctions is shown.

Crime	Penalties
Attempt on the safety of nuclear installations or facilities, sites or facilities used for the production, storage or transport of nuclear material, if it will be resulting in risk for public safety.	6 – 20 years' imprisonment. Fine from 26 000 to 260 000 €. [39, 40]
Purchase, receipt, possession, sale to third parties, use, transportation, importation, exportation, processing, disposal or dispersal of nuclear material capable of causing death or personal injury to one or more persons or significant damage to property or to environment.	2 – 6 years' imprisonment. Fine from 5 000 to 20 000 €. If there is the possibility that these acts will cause enduring damage: 3 – 7 years' imprisonment. Fine from 50 000 to 250 000 €. [40]
Holder of licencing that non respects prescription	Fine from 3 000 to 15 000 €. [40]
Exporting without authorization related products to the nuclear materials contained in the list defined by a joint decree of the ministry of defense and ministry in charge of industry; Unduly obtaining by any fraudulent means the authorization to export these same products.	2 – 4 years' imprisonment. Fine of 2 – 10 million ITL $(1€ = 1936.27 ITL)$. [52]
Start up a NPP without authorization.	2 – 3 years' imprisonment. Fine of 5 – 10 million ITL $(1€ = 1936.27 ITL)$. [52]
Transporting radioactive substances without authorization.	Fine of 500 000 – 1 000 000 ITL $(1€ = 1936.27 ITL)$. [52]

Tab. 5.2 : Penalties in Italy.

6 The American's case

The USA is the world's largest producer of nuclear power, accounting for more than 30% of worldwide nuclear generation of electricity. The country has 104 nuclear reactors produced 807 billion kWh in 2010, over 20% of total electrical output. There are 69 pressurized water reactors (PWRs) with combined capacity of about 67 GWe and 35 boiling water reactors (BWRs) with combined capacity of about 34 GWe – for a total capacity of 101 236MWe (see Figure 6.1 for details [53]). Following a period of 30 years in which few new reactors were built, it is expected that 4 – 6 new units may come on line by 2020.

Fig. 6.1 : USA Operating Nuclear Power Reactors.

The USA nuclear policy is complex and a lot of department and agencies are present to regulate and organize nuclear activities. Before the Energy Reorganization Act of 1974 [54], nuclear regulation was responsibility of the Atomic Energy Commission (AEC), which Congress first established in the Atomic Energy Act of 1946 [55]. Eight years later, Congress replaced that law with the Atomic Energy Act of 1954 [56], which for the first time made the development of commercial nuclear power possible. The act assigned at the AEC functions of both encouraging the use of nuclear power and regulating its safety. The AEC's regulatory programs sought to ensure public health and safety from the hazards of nuclear power without imposing excessive requirements that would inhibit the growth of the industry. By 1974, the AEC's regulatory programs had come under such strong attack that Congress decided to abolish the agency and the NRC was instituited (see 6.1) [57].

Moreover, the USA has a federal system of government with some powers and responsibilities carried out by states and municipalities, including the taxation and regulation of property and certain commercial activity within their boundaries. This means that, while the national government in Washington has primary jurisdiction with respect to most nuclear policy matters, states as well as local governments can have a significant impact on nuclear power use and capacity. For example, in 1976 the California state approved a law to prohibit the construction of new nuclear power plants until approval of a means to dispose of spent fuel.

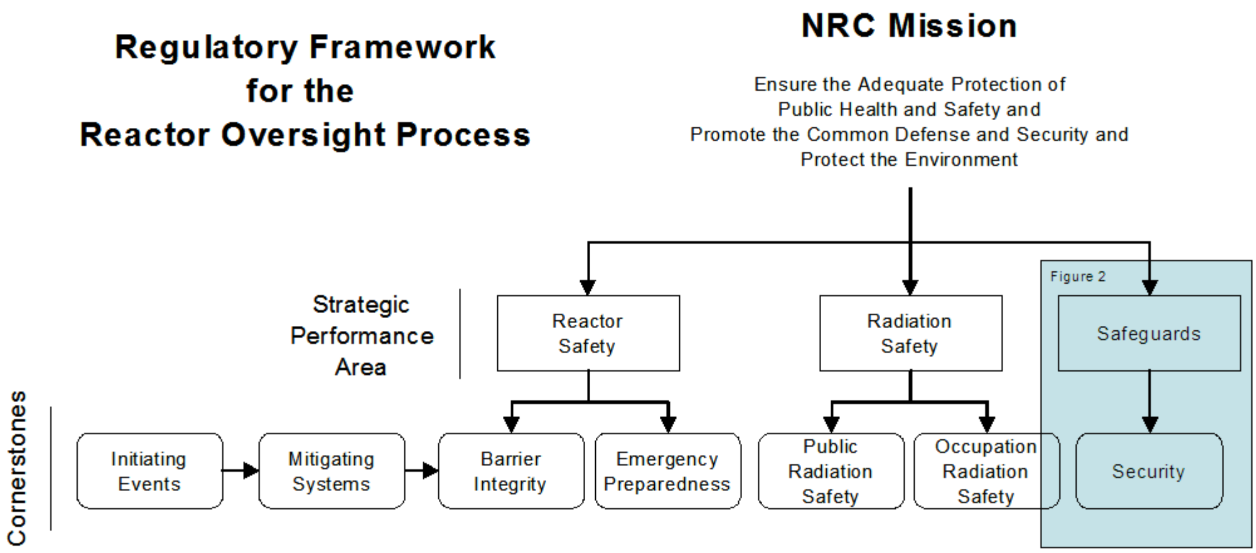


Fig. 6.2 : NRC's regulatory process.

6.1 US Nuclear Regulatory Commission (NRC)

After the abolishment of the AEC, with the Energy Reorganization Act of 1974 [54], the NRC was instituited and its promotional activities were placed in the Energy Research and Development Administration (later the US Department of Energy - see Section 6.2). The NRC began operations on January 19th 1975 [58]. It is an independent government agency that regulates all aspects of the nuclear industry in the USA, including reactors, fuel cycle facilities and the transportation, disposal and storage of spent fuel [59]. In particular, the NRC's regulatory activities are focused on reactor safety oversight and reactor license renewal of existing plants, materials safety oversight and materials licensing for a variety of purposes, and waste management of both high-level waste and low-level waste (see Figure 6.2 [60]). In addition, the NRC is preparing to evaluate new applications for nuclear plants. In this respect, the NRC continues to implement the Reactor Oversight Process (ROP), which is the agency's program for inspecting and assessing licensee performance at operating NPPs in a manner that is risk-informed, objective, predictable, and understandable. ROP instructions and inspection procedures help ensure that licensee actions and regulatory responses are commensurate with the safety or security significance of the particular event, deficiency, or weakness. Within each ROP cornerstone (see Figure 6.3 [61]), NRC inspectors implement inspection procedures, and NPP licensees report performance indicator results to the NRC. The security cornerstone focuses on the following five key licensee performance attributes: access authorization, access control, physical protection systems, material control and accounting, and response to contingency events.

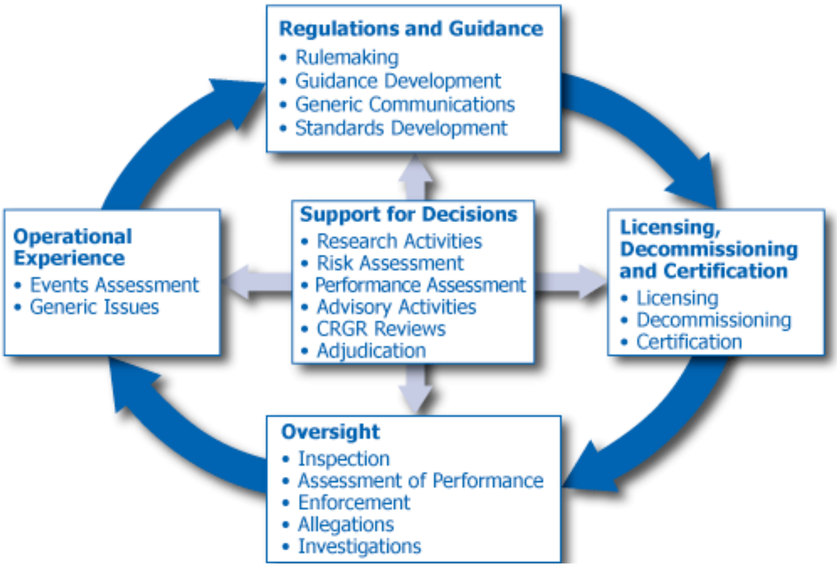


Fig. 6.1: Cornerstones of the Reactor Oversight Process.

The NRC is headed by a five-member Commission. The President designates one member to serve as Chairman and official spokesperson. The Executive Director for Operations (EDO) carries out the policies and decisions of the Commission and directs the activities of the program offices [62].

6.2 US Department of Energy (DOE)

The US Department of Energy was formed in 1977 and it brought together activities under the AEC as the civil successor to the Manhattan Project, the Energy Research and Development Administration (ERDA) which succeeded it in 1974, and other bodies (see Figure 6.4 [63]). The

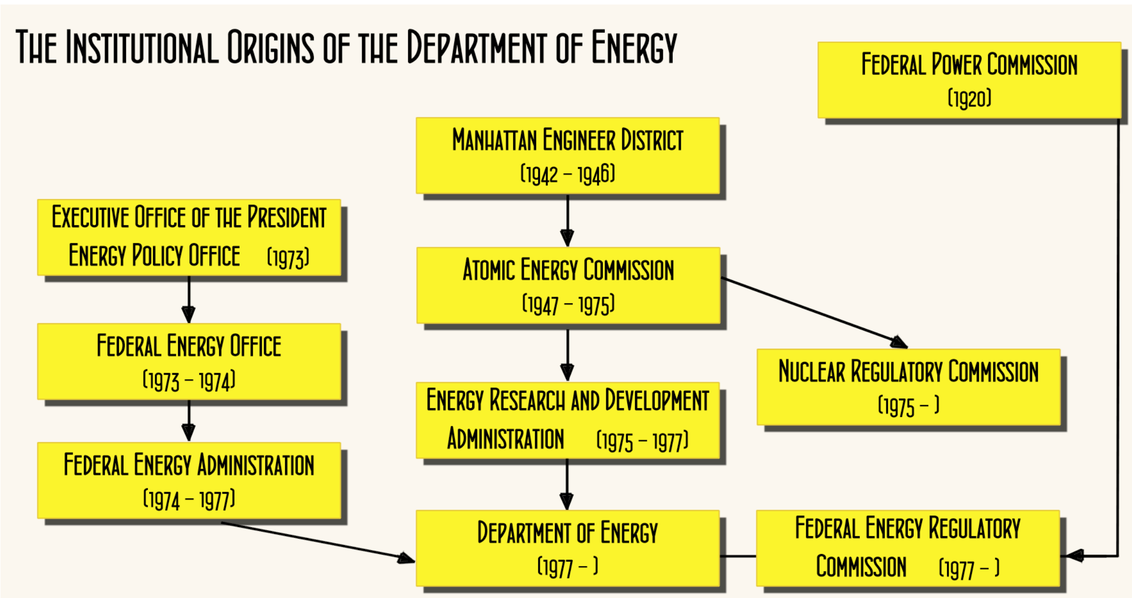


Fig. 6.2: The institutional origins of the Department of Energy.

purpose was to achieve better coordination of policy by putting previously disparate agencies and programs together into a single Cabinet level department. The Secretary of Energy reports to the President. The DOE's responsibilities include policy and funding for programs not only on nuclear energy, but also on fossil fuels, hydropower and alternative sources of energy. The DOE also manages the government's 21 national laboratories.

In addition to the DOE's responsibilities for civilian nuclear energy, its National Nuclear Security Administration (NNSA) oversees the military application of nuclear en ergy, maintaining the country's weapons stockpile and managing the design, production and testing of nuclear weapons [59].

6.3 Physical protection of facilities

For the regulation of physical protection of facilities in USA, the NRC regulation title 10 of "Code of Federal Regulations", part 73 is to be considered [64]. Parts from 73.40 to 73.61 describe the requirements for physical protection against radiological sabotage, or against theft of special nuclear material, or against both at fixed sites, be they licensed ativities, storage, NPPs or nonpower reactors. Moreover, for NPPs, in part 73.58, the safety/security interface requirements are described. In this respect, in the regulation is written:

> *"(b) The licensee shall assess and manage the potential for adverse effects on safety and security, including the site emergency plan, before implementing changes to plant configurations, facility conditions, or security.*
> *(c) The scope of changes to be assessed and managed must include planned and emergent activities (such as, but not limited to, physical modifications, procedural changes, changes to operator actions or security assignments, maintenance activities, system reconfiguration, access modification or restrictions, and changes to the security plan and its implementation).*
> *(d) Where potential conflicts are identified, the licensee shall communicate them to appropriate licensee personnel and take compensatory and/or mitigative actions to maintain safety and security under applicable Commission regulations, requirements, and license conditions."*

A licensee physical protection system, at fixed sites, shall include the following measures:

- Security organization: guards armed with a handgun and Tactical Response Team (each TRT member shall be armed with a 9 mm semiautomatic pistol; all but one member of the TRT shall be armed additionally with either a shotgun or semiautomatic rifle, the remaining member of the TRT shall carry a rifle of no less caliber than 7.62mm). TRT members, armed response personnel, and guards shall qualify and requalify, at least every 12 months, for day and night firing with assigned weapons. In addition, in the part 73.46 of 10 CFR, all the tecnical and physical training requirements are specified.

- Physical barrier subsystems: for the structure of PPS see Figure 6.5. Moreover these structures, a numbered picture badge identification subsystem shall be used for all individual. All points of personnel and vehicle access into a protected area shall be controlled for firearms, explosives, and incendiary devices except for Federal, State, and local law enforcement personnel on official duty and United States Department of Energy couriers engaged in the transport of special nuclear material. The individual responsible for the last access control function (controlling admission to the protected area) shall be isolated within a structure with bullet resisting walls, doors, ceiling, floor, and windows.

Physical protection system, at licensed activities (possesses, uses, or stores formula quantities of strategic special nuclear material that are not readily separable from other radioactive material and which have total external radiation dose rates in excess of 100rems/h at a distance of 3 feet from any accessible surfaces without intervening shielding), shall include the following measures:

- Security organization including guards, to protect his facility against radiological sabotage and the special nuclear material in his possession against theft. At least one supervisor of the security organization shall be on site at all times.
- Physical barrier as described in Figure 6.6. All alarms required shall annunciate in a continuously manned central alarm station located within the protected area and in at least one other continuously manned station such that a single act cannot remove the capability for calling for assistance or otherwise responding to an alarm. All alarms shall be self-checking and tamper indicating. The annunciation of an alarm at the onsite central station shall indicate the type of alarm (e.g., intrusion alarm, emergency exit alarm, etc.) and location.

Physical protection systems of licensee that stores spent nuclear fuel and high-level radioactive waste shall include the following measures:

- The security organization must include sufficient personnel per shift to provide for monitoring of detection systems and the conduct of surveillance, assessment access control, and communications to assure adequate response. Members of the security organization must be trained, equipped, qualified, and requalified to perform assigned job duties.
- Physical barrier as described in Figure 6.7.

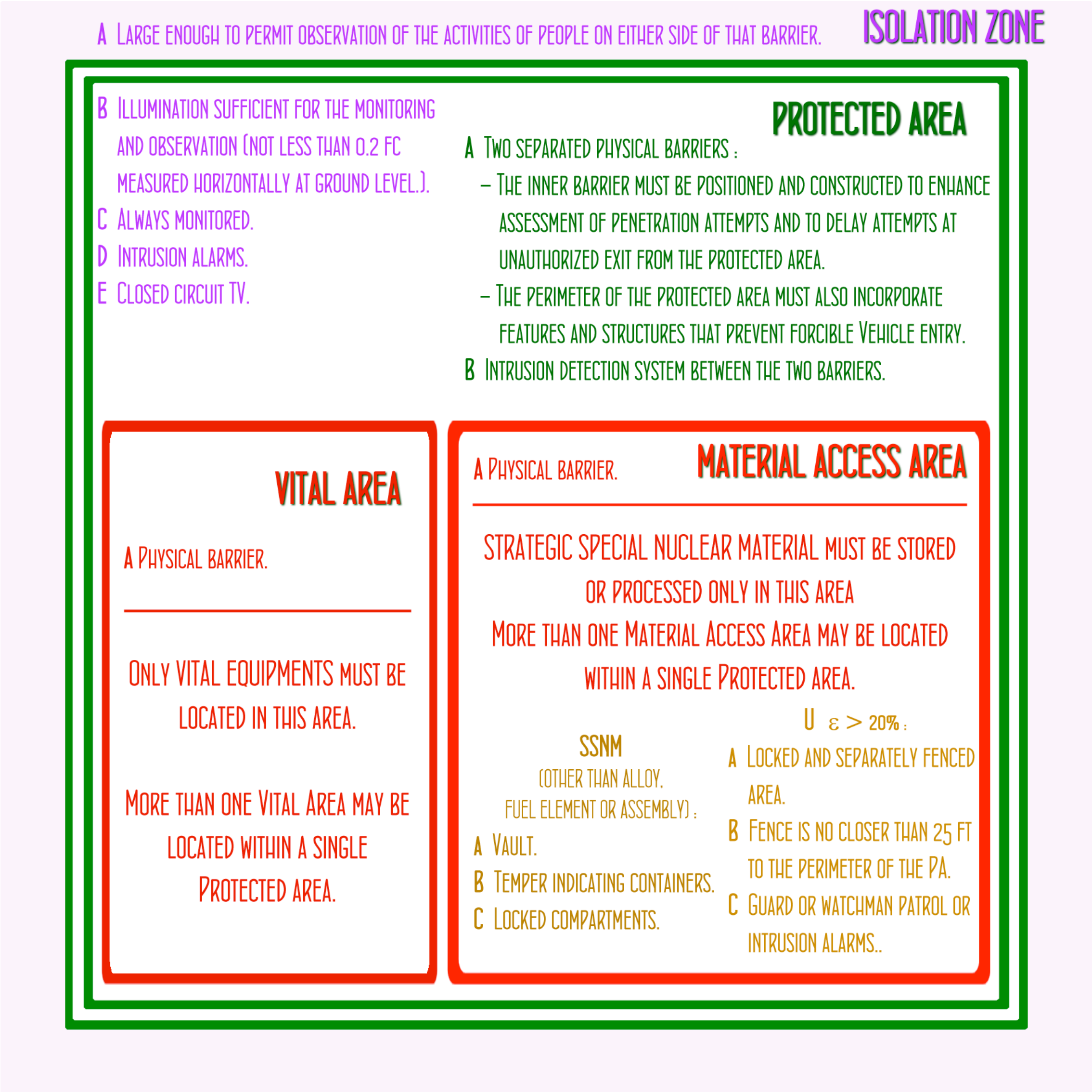


Fig. 6.3: Physical Protection System at fixed sites in USA.

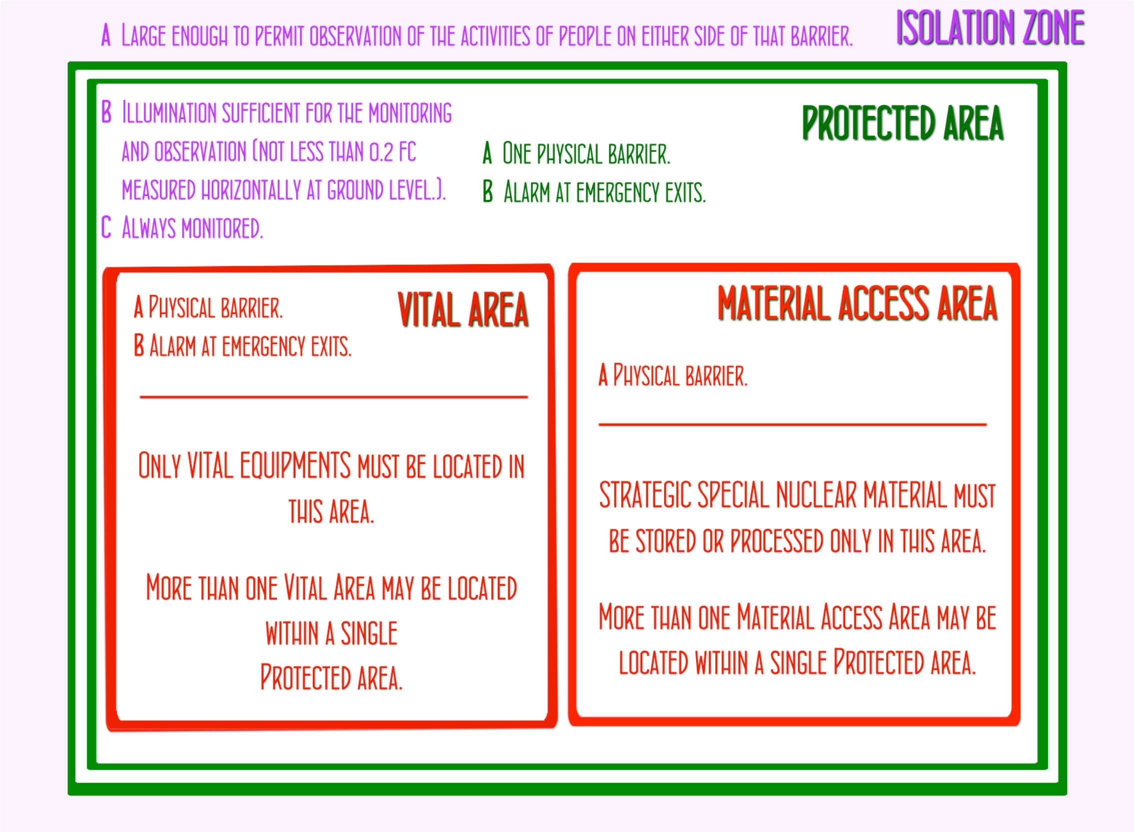


Fig. 6.4: Physical Protection System at licensed activities in USA.

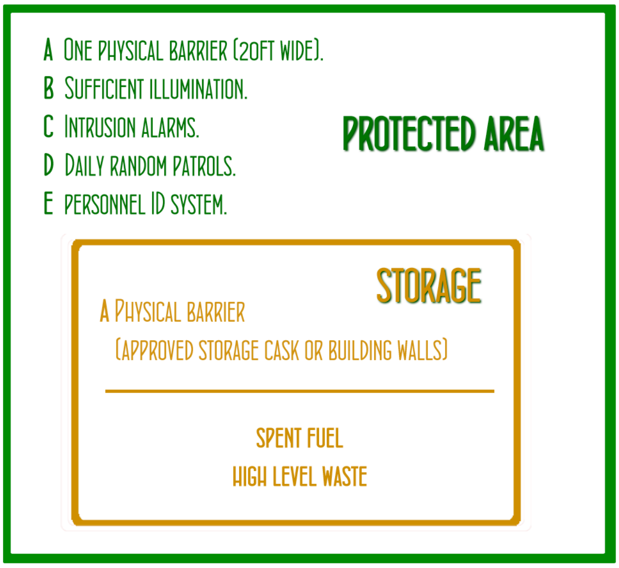


Fig. 6.5: Physical Protection System at storages in USA.

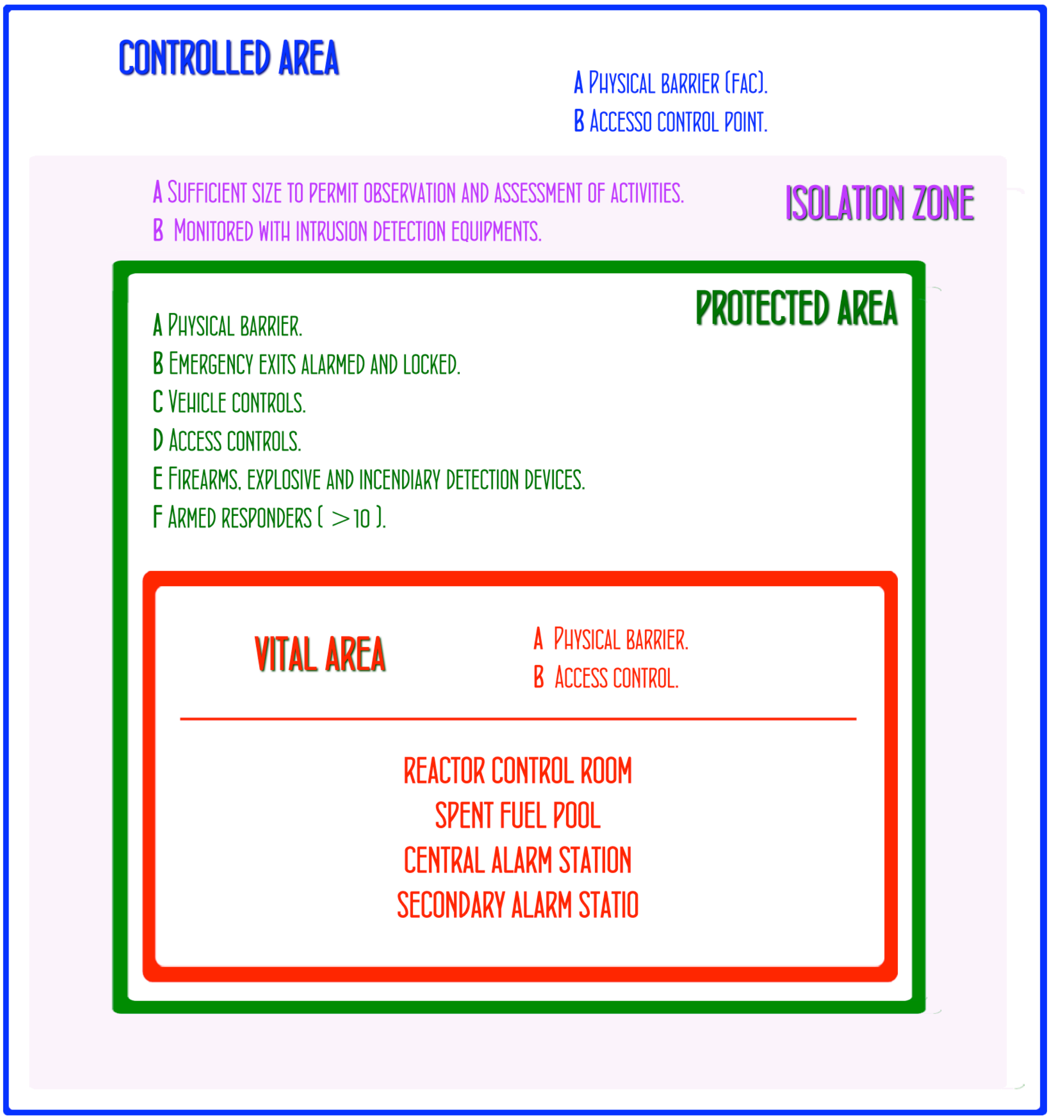


Fig. 6.6: Physical Protection System at nuclear power reactors in USA.

In the paragraph 73.55 of 10 CFR, the requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage are described. The main requirements are:

- The identification and description of the security plan that must describe how the licensee will implement requirements through the establishment and maintenance of a security organization, the use of security equipment and technology, the training and qualification of security personnel, the implementation of predetermined response plans and strategies, and the protection of digital computer and communication systems and networks.
- Security organization with st least one member, onsite and available at all times, who has the authority to direct the activities of the security organization.
- Physical barrier: the reactor control room, the central alarm station, and the location within which the last access control function for access to the protected area is performed, must be bullet-resisting. See Figure 6.8 for details.
- As a minimum the licensee shall review each element of the physical protection program at least every 24 months.

6.4 Physical protection & Accountancy of nuclear material

The classification of nuclear materials, has found in the 10 CFR part 73.2 [64], has some changes compared with the CPPNM classification. Details are presented in Table 6.1. For the physical protection on these materials the regulation in law is the 10 CFR part 73.67, while for the control and accountancy is the 10 CFR part 74 [65]. The requisites for the physical protection are:

- For material of low strategic significance, the storage or use must be limited in a controlled access area with an intrusion alarm or other device or procedures.
- For material of moderate strategic significance, the use must be limited in controlled access area which is illuminated sufficiently to allow detection and surveillance of unauthorized penetration or activities; the storage, instead, must be performed using vault-type room or approved security cabinet. Materials must be monitored with intrusion alarm or other device or procedures to detect unauthorized penetration or activities. Moreover, a search on a random basis of vehicles and packages leaving the controlled access areas must be performed.

As regard the control of nuclear materials, in case of loss or theft or other unlawful diversion of special nuclear material which the licensee is licensed to possess, or any incident in which an attempt has been made to commit a theft or unlawful diversion of special nuclear material, each licensee who possesses one gram or more of contained U235, U233 or Pu shall notify the NRC Operations Center within 1h.

Material Special Nuclear Material (SNM)	Form	Category I Strategic significance	Category II Moderate strategic significance	Category III Low strategic significance
Pu	Unirradiated	Any combination more than 5 kg computed by the "formula quantity"[a]	Less than I but more than 500 g; Any combination more than 1 kg computed by the "formula quantity"[b]	Less than II but more than 15 g; Any combination more than 15 g computed by the "formula quantity"[c]
^{235}U	U enriched to 20% ^{235}U or more	Any combination more than 5 kg computed by the "formula quantity"[a]	Less than I but more than 1 kg; Any combination more than 1 kg computed by the "formula quantity"[b]	Less than II but more than 15 g; Any combination more than 15 g computed by the "formula quantity"[c]
	U enriched to 10% ^{235}U, but less than 20%		10 kg or more	Less than 10 kg but more than 1 kg
	U enriched above natural, but less than 10%			10 kg or more
^{233}U	Unirradiated	Any combination more than 5 kg computed by the "formula quantity"[a]	Less than I but more than 500 g; Any combination more than 1 kg computed by the "formula quantity"[b]	Less than II but more than 15 g; Any combination more than 15 g computed by the "formula quantity"[c]

[a] $\text{grams} = \left(\text{gramscontainedU}^{235}\right) + 2.5\left(\text{gramsU}^{233} + \text{gramsPu}\right)$.
[b] $\text{grams} = \left(\text{gramscontainedU}^{235}\right) + 2\left(\text{gramsU}^{233} + \text{gramsPu}\right)$.
[c] $\text{grams} = \left(\text{gramscontainedU}^{235}\right) + \left(\text{gramsU}^{233}\right) + (\text{gramsPu})$.

Tab. 6.1: Categorization of Nuclear Material in USA.

Regarding the accountancy of nuclear materials, each licensee possessing, or who had possessed in the previous reporting period, at any one time and location, special nuclear material in a quantity totaling one gram or more of contained U235, U233 or Pu shall complete and submit, in computer-readable format Material Balance Reports concerning special nuclear material that the licensee has received, produced, possessed, transferred, consumed, disposed, or lost. With each Material Balance Report, the Physical Inventory Listing Report must be submitted. Reports must be submitted for each Reporting Identification Symbol (RIS) account including all holding accounts. Moreover, in case of discrepancy identified during the report review and reconciliation process, each licensee shall resolve these discrepancies within 30 calendar days of notification of a discrepancy identified by NRC.

- For material of low strategic significance, in each inventory period, control total material control and accounting measurement uncertainty so that twice its standard error is less than the greater of 9 000g of U235 or 0.25% of the active inventory. The physical inventory must be performed at least every 12 months and, within 60 days after the start of the inventory, reconcile and adjust the book inventory to the results of the physical inventory, and resolve, or report an inability to resolve, any inventory difference which is rejected by a statistical test which has a 90 % power of detecting a discrepancy of a quantity of U235 established by NRC on a site-specific basis.

- For material of moderate strategic significance, the physical inventories of all possessed SNM for each plant shall be conducted at intervals not to exceed 9 calendar months and within 60 calendar days after the start of each physical inventory the inventory difference (ID) and its associated standard error of inventory difference (SEID) for both element and isotope must be calculated, for the material balance period terminated by the physical inventory. Moreover, the material control and accountancy system must incorporate checks and balances that are sufficient to detect falsification of data and reports that could conceal diversion of SNM by a single individual (including an employee in any position) or collusion between two individuals (one or both of whom have authorized access to SNM).
- For material of strategic significance, other than the previously measure, a statistical test, that has at least a 95% power of detecting an abrupt loss of five formula kilograms within three working days of a loss of Category IA[6] material from any accessible process location and within seven calendar days of a loss of Category IB2[7] material from any accessible process location, shall be present in the control program. The detection capability must be sufficient for laboratory samples containing less than 0.05 formula kilograms of SSNM and the licensee shall verify on a statistical sampling basis, the presence and integrity of SSNM items.

6.5 Emergency and contingency plans

As a condition of their license, operators of NPPs must develop and maintain Emergency Preparedness (EP) plans that meet comprehensive NRC EP requirements. The regulations for this case are the 10 CFR part 50.47 and appendix E, the NUREG-0800 part 13.3 and 14.3.10, the NUREG-0654/FEMA-REP-1, the NUREG-0696 and the NUREG-0737 [66, 67, 68, 69, 70, 71, 72]. The NRC assesses the capabilities of the nuclear power plant operator to protect the public by requiring the performance of a full-scale exercise at least once every two years that includes the participation of government agencies. These exercises are performed in order to maintain the

[6] Category IA material means SSNM directly useable in the manufacture of a nuclear explosive device, except if:

- The dimensions are large enough (at least 2 m in one dimension, greater than 1 m in each of two dimensions, or greater than 25 cm in each of three dimensions) to preclude hiding the item on an individual;
- The total weight of an encapsulated item of SSNMis such that it cannot be carried inconspicuously by one person (i.e., at least 50 kg gross weight);
- The quantity of SSNM (less than 0.05 formula kilograms) in each container requires protracted diversions to accumulate five formula kilograms.

[7] Category IB material means all SSNM material other than Category IA.

Notification of Unusual Event	Alert	Site Area Emrgency	General Emergency
Events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation occurs.	Events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the EPA Protective Action Guideline exposure levels (see 6.10, 6.4 and 6.5).	Events in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed the EPA PAGs except near the site boundary.	Events in process or have occurred which involve actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area.

Tab. 6.2: Licensee Emergency Classes fo NPPs.

Alert	Site Area Emergency
Events may occur, are in progress, or have occurred that could lead to a release of radioactive materials, but the release is not expected to require a response by an offsite response organization to protect people offsite.	Events may occur, are in progress, or have occurred that could lead to a significant release of radioactive materials, and the release could require a response by offsite response organizations to protect people offsite.

Tab. 6.3: Licensee Emergency Classes for nuclear materials and fuel cycle facility licensees.

skills of the emergency responders and to identify and correct weaknesses. They are evaluated by NRC inspectors and FEMA (Federal Emergency Management Agency)[8] evaluators. Between these two-year exercises, additional drills are conducted by the nuclear power plant operators that are evaluated by NRC inspectors.

NRC is the Coordinating Agency for radiological events occurring at NRC-licensed facilities and for radioactive materials either licensed by NRC or under NRC's Agreement States Program. As Coordinating Agency, NRC has technical leadership for the Federal government's response to the event. If the severity of an event rises to the level of General Emergency (see Table 6.2 and Table 6.3 for detailed description of emergency levels [73]), or is terrorist-related [74], Department of Homeland Security will take on the role of coordinating the overall Federal response to the event,

[8] The FEMA coordinates the federal government's role in preparing for, preventing, mitigating the effects of, responding to, and recovering from all domestic disasters, whether natural or man-made, including acts of terror.

while NRC would retain a technical leadership role, other Federal agencies who may respond to an event at an NRC-licensed facility, or involving NRC-licensed material, include Federal Emergency Management Agency, the Department of Energy, the Environment Protection Agency, the Department of Agriculture, the Department of Health and Human Services, the National Oceanographic and Atmospheric Administration, and the Department of State (see Figure 6.9 [73]).

Immediately upon becoming aware that an incident has occurred that may result in a radiation dose that exceeds federal government protective action guides, responsible nuclear power plant personnel evaluate plant conditions and then make EPA PAGs to the State and local government agencies on how to protect the population. Nuclear power plant personnel are required to report the PARs to the State or local government agencies (within 15 minutes). State and local officials make the final decision on what protective action is necessary to protect public health and safety, and then relay these decisions to the public in a timely manner (normally within approximately 15 minutes).

The Preliminary Safety Analysis Report shall contain sufficient information to ensure the compatibility of proposed emergency plans for both onsite areas and the Emergency Planning Zones (EPZs), with facility design features, site layout, and site location with respect to such considerations as access routes, surrounding population distributions, land use, and local jurisdictional boundaries for the EPZs in the case of nuclear power reactors. EPZs for power reactors are discussed in NUREG–0396 and EPA 520/1–78–016. There are two EPZs around each nuclear power plant:

- The Plume Exposure Pathway EPZ has a radius of about 10miles from the reactor site. Predetermined protective action plans are in place for this EPZ and are designed to avoid or reduce dose from potential exposure of radioactive materials. These actions include sheltering, evacuation, and the use of potassium iodide where appropriate (see Figure 6.11 [75]).
- The ingestion exposure pathway EPZ has a radius of about 50 miles from the reactor site. Predetermined protective action plans are in place for this EPZ and are designed to avoid or reduce dose from potential ingestion of radioactive materials. These actions include a ban of contaminated food and water.

The size of the EPZs for a nuclear power plant shall be determined in relation to local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case-by-case basis for gascooled nuclear reactors and for reactors with an authorized power level less than 250MWt. Generally, the plume exposure pathway EPZ for nuclear power plants with an authorized power level greater than 250MWt shall consist of an area about 16 km in radius and the ingestion pathway EPZ shall consist of an area about 80 km in radius.

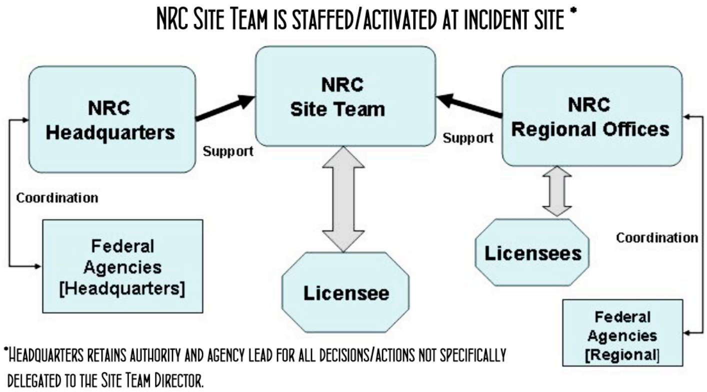


Fig. 6.8: NRC activation responce mode.

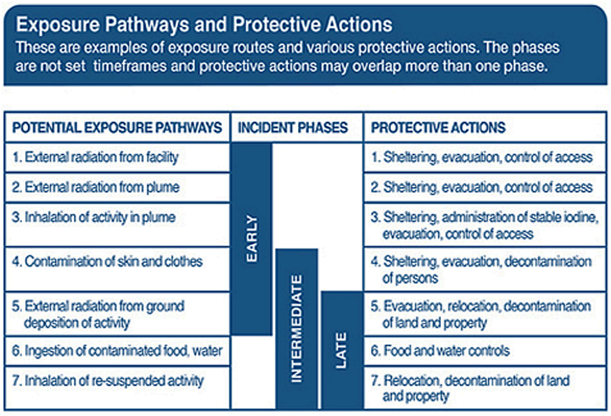


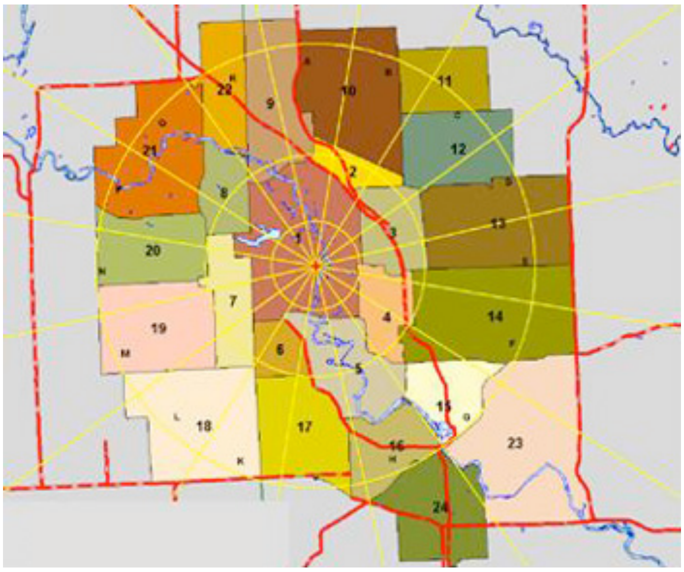
Fig. 6.7: EPA exposure pathways, incident phases, and protective actions.

Protective Action	PAG (projected dose)	Comments
Evacuation (or sheltering)	1 – 5 rem	Evacuation (or, for some situations, sheltering) should normally be initiated at 1 rem.
Administration of stable iodine	25 rem	Requires approval of State medical officials.

Tab. 6.4: PAGs for the Early Phase of a nuclear incident.

Protective Action	PAG (projected dose)	Comments
Relocate the general population	≥ 2 rem	Beta dose to skin may be up to 50 times higher.
Apply simple dose reduction techniques	< 2 rem	These protective actions should be taken to reduce doses to as low as practicable levels.

Tab. 6.5 : PAGs for exposure to deposited radioactivity during the Intermediate Phase of a nuclear incident.



The center of the map is the location of the commercial nuclear power plant reactor building. Concentric circles of 2, 5, and 10 miles have been drawn and divided into triangular sectors identified by letters from A to R. Municipalities identified to be within the 10-mile EPZ have been assigned numbers from 1 to 24. The triangular sectors provide a method of identifying what municipalities are affected by the radioactive plume as it travels.

Fig. 6.9: Typical 10-Mile Plume Exposure Pathway EPZ Map

6.6 Penalties

The Atomic Energy Act of 1954, as amended [56], describe all the sanctions and penalties coming not only from the non conformity with the laws, but also from malevolent act against nuclear materials and facilities. In Table 6.6 a summary of these sanctions is shown.

Crime	Penalties
Transfer or receive in interstate commerce, transfer, deliver, acquire, own, possess, receive possession of or title to, or import into or export from the US any SNM unless authorization. Transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export any utilization or production facility without a license. Interferes, attempts to interfere, or conspires to interfere with the suspension of any licenses in case of state of war or national emergency.	$<$ 10 years' imprisonment. Fine of 10 000 \$. With intent to injure the US or to secure an advantage to any foreign nation: imprisonment for life. Fine of not more than 20 000 \$.
Knowingly participate in the development of, manufacture, produce, transfer, acquire, receive, possess, import, export, or use, or possess and threaten to use, any atomic weapon.	Imprisonment for life or $>$ 25 years. Fine of 2 000 000 \$. With intent to injure the US or to secure an advantage to any foreign nation: imprisonment for life or $>$ 30 years. Fine of 2 000 000 \$.

continued on the next page

Crime	Penalties
Individual director, officer or employee of a person indemnified under an agreement of indemnification who, by act or omission, knowingly and willfully violates or causes to be violated any section of the Atomic Energy Act or any applicable nuclear safety-related rule, regulation or order issued thereunder by the Secretary of Energy, which violation results in or, if undetected, would have resulted in a nuclear incident.	$<$ 2 years' imprisonment. Fine of not more than 25 000 \$ for each day of violation. If the conviction is for a violation committed after a first conviction: $<$ 2 years' imprisonment. Fine of not more than 50 000 \$ per day of violation.
Individual director, officer, or employee of a firm constructing, or supplying the components of any utilization facility who by act or omission, in connection with such construction or supply, knowingly and willfully violates or causes to be violated, any section of the Atomic Energy Act or any license condition, which violation results, or if undetected could have resulted, in a significant impairment of a basic component of such a facility.	$<$ 2 years' imprisonment. Fine of not more than 25 000 \$ for each day of violation. If the conviction is for a violation committed after a first conviction: $<$ 2 years' imprisonment. Fine of not more than 50 000 \$ per day of violation.
Willfully violates, attempts to violate, or conspires to violate, any provision of the Atomic Energy Act for which no criminal penalty is specifically provided.	$<$ 10 years' imprisonment. Fine of 5 000 \$. With intent to injure the US or to secure an advantage to any foreign nation: $<$ 20 years' imprisonment. Fine of not more than 20 000 \$.

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Crime	Penalties
Entry upon or carrying, transporting, or otherwise introducing or causing to be introduced any dangerous weapon, explosive, or other dangerous instrument or material likely to produce substantial injury or damage to persons or property, into or upon any facility, installation, or real property subject to the jurisdiction, administration, in the custody of the Commission.	Fine of not more than 1 000 $. If installation or other property is enclosed by a fence, wall, floor, roof, or other structural barrier shall be guilty of a misdemeanor and upon conviction thereof shall be punished by: $<$ 1 years' imprisonment. fine of not more than 5 000 $.

end

Tab. 6.6: Penalties in USA.

List of Figures

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References

[1] International Nuclear Safety Group, Strengthening the global nuclear safety regime, INSAG series, ISSN 1025-2169; INSAG-21 (2006).
[2] International Nuclear Safety Group, The interface between safety and security at nuclear power plants, INSAG series, ISSN 1025-2169; no. 24 (2010).
[3] S. Squassoni, Nuclear Safety and Security at the 2012 Seoul Nuclear Security Summit, US-Korea Institute at SAIS, 2012.
[4] IAEA, Convention on Early Notification of a Nuclear Accident and Convention on assistance in the Case of a Nuclear Accident or Radiological Emergency, Legal Series No. 14 (1986).
[5] IAEA, Convention on Nuclear Safety, Legal Series No. 16 (July 1994).
[6] IAEA, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, INFCIRC/546 (December 1997).
[7] IAEA, Code of Conduct on the Safety and Security of Radioactive Sources (2004).
[8] IAEA, Code of Conduct on the Safety of Research Reactors, adopted by the Board of Governors, GC(48)/7 (2004).
[9] IAEA, Recommendation for Physical Protection of Nuclear Material (1972).
[10] IAEA, The Physical Protection of Nuclear Material, INFCIRC/225 Rev.4 Corrected) (1999).
[11] IAEA, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), IAEA Nuclear Security Series no. 13 (1999).
[12] IAEA, Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1 (March 1980).
[13] IAEA, Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6 (2005).
[14] IAEA, International Convention for the Suppression of Acts of Nuclear Terrorism, GC(49)/RES/10 (2005).
[15] UN, United Nations Security Council Resolution 1540, new York (April 2004).
[16] UN, United Nations Security Council Resolution 1373, new York (2001).
[17] World Institute for Nuclear Security, SECURING THE FUTURE. A Compendium of Best Practices for Nuclear Security Management, Seoul 2012 (2012).
[18] C. Stoiber et al., Handbook on Nuclear Law, International Atomic Energy Agency, 2003.
[19] C. Stoiber et al., Handbook on Nuclear Law: implementing legislation, International Atomic Energy Agency, 2010.
[20] IAEA, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, Nuclear Security Series no. 13, INFCIRC/225/Revision 5 (2011).
[21] IAEA, IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection (2007).
[22] International Nuclear Safety Advisory Group, Defence in Depth in Nuclear Safety, INSAG series, ISSN 1025-2169; no. 10 (1996).
[23] Council of the European Union, Report of the Ad Hoc Group on Nuclear Security, AHGNS 20 ATO 84 (May 2012).
[24] IAEA, Map of countries supporting the CPPNM. URL http://www-ns.iaea.org/conventions/physical-protection.asp
[25] IAEA, Measures to Improve the Security of Nuclear Materials and other Radioactive Materials, GC(45)/INF/14 (September 2001).
[26] Chapitre II: Protection des et suivants installations d'importance vitale, Code de la defense - Partie legislative - Article L 1332-1 et suivants (October 2011).
[27] Chapitre III : Matieres et installations nucleaires, Code de la defense - Partie legislative - Article L 1333-1 et suivants (October 2011).
[28] Chapitre II: Protection des installations d'importance vitale, Code de la defense - Partie reglementaire - Article R 1332-1 et suivants (October 2011).

[29] Chapitre III : Matieres et installations nucleaires, Code de la defense - Partie reglementaire - Article R 1333-1 et suivants (October 2011).
[30] LOI no 2006-686 du 13 juin 2006 relative a la transparence et a la securite en matiere nucleaire, Journal Officiel de la Republique Francaise, NOR: DEVX0100081L (June 2006).
[31] Arrete du 10 juin 2011 relatif a la protection physique des installations abritant des matieres nucleaires dont la detention releve d'une autorisation, NOR: DEVK1107105A (June 2011).
[32] Arrete du 9 juin 2011 fixant les conditions de mise en auvre du suivi physique et de la comptabilite des matieres nucleaires dont la detention releve d'une autorisation, NOR: DEVK1009815A (June 2011).
[33] ASN, Annual report: Nuclear safety and radiation protection in France in 2008 (2008). URL http://annual-report2008.asn.fr
[34] ASN, Annual report: Nuclear safety and radiation protection in France in 2010 (2010). URL http://annual-report2010.asn.fr
[35] Les situations d'urgence. URL www.asn.fr/index.php/S-informer/Dossiers
[36] Steering Committee for Post-Accident Management in the Event of a Nuclear Accident or Radiological Emergency Situation - CODIRPA -, National preparedness guide for exiting the emergency phase subsequent to a nuclear accident causing moderate, short-term release on french soil, Working document Version 0 (May 2010).
[37] Decision n. 2009-DC-0153 de l'Autorite de surete nucleaire du 18 aout 2009 relative aux niveaux d'intervention en situation d'urgence radiologique, Republique Francaise - ASN (August 2009).
[38] Ratifica ed esecuzione della convenzione sulla protezione fisica dei materiali nucleari, con allegati, aperta alla firma a Vienna ed a New York il 3 marzo 1980, LEGGE 7 agosto 1982, n. 704 (August 1982).
[39] Disegno di legge - Ratifica ed esecuzione degli Emendamenti alla Convenzione sulla protezione fisica dei materiali nucleari del 3 marzo 1980, adottati a Vienna l'8 luglio 2005, nonche' norme di adeguamento dell'ordinamento interno, Atto Senato n. 2942 - XVI Legislatura (October 2011).
[40] Modifiche al disegno di legge n. 2942, Esito: concluso l'esame (proposto testo modificato) (May 2012).
[41] Italian Senate website. URL http://www.senato.it/leg/16/BGT/Schede/Ddliter/comm/37437_comm.htm
[42] Disposizioni per lo sviluppo e l'internazionalizzazione delle imprese, nonche' in materia di energia, LEGGE 23 luglio 2009, n. 99 (July 2009).
[43] Modifiche a seguito del referendum, DECRETO-LEGGE 31 marzo 2011, n. 34 (March 2011).
[44] Detenzione e contabilita' delle materie fissili speciali, materie grezze, minerali e combustibili nucleari, D.M. 28-09-2011 - G.U. 24-10-2011, n. 248 (September 2011).
[45] Modalita' relative alla denunzia di detenzione e alla tenuta della contabilita' delle materie radioattive, D.M. 27-07-1966 - G.U. 14-11-1966, n. 285, Serie Generale (July 1966).
[46] Modificazioni al decreto ministeriale 27 luglio 1966, G.U. 16-10-1982, n. 286 (October 1982).
[47] Esonero dalla denuncia e dalle autorizzazioni prescritte dalla L. 31-12-1962, n. 1860, in applicazione della L. 19-12-1969, n. 1008, D.M. 15-12-1970 - G.U. 15-02-1971, n. 39 (December 1970).
[48] Attuazione della direttiva 96-29-EURATOM in materia di protezione sanitaria della popolazione e dei lavoratori contro i rischi derivanti dalle radiazioni ionizzanti, DL 26-05-2000, n. 241 (May 2000).
[49] Attuazione delle direttive EURATOM 807836, 84-467, 84-466, 89-618, 90-641 e 92-3 in materia di radiazioni ionizzanti, DL 17-03-1995, n. 230 - G.U. 13-06-1995 (March 1995).

[50] Linee Guida per la predisposizione del piano d'emergenza esterna di cui all'articolo 20, comma 4, del decreto legislativo 17 agosto 1999, n. 334., DPCM 25-02-2005 - G.U. 16-03-2005 (February 2005).
[51] D. d. P. C. Presidenza del Consiglio dei Ministri, Piano nazionale delle misure protettive contro le emergenze radiologiche.
[52] ISPRA, Convention on Nuclear Safety, Extraordinary Meeting 2012, National Report of ITALY (May 2012).
[53] U.S.NRC, Operating Nuclear Power Reactors (by Location or Name).
URL http://www.nrc.gov/info-finder/reactor/
[54] ENERGY REORGANIZATION ACT OF 1974, AS AMENDED, Public Law 93-438, 88 STAT. 1233 (October 1974).
[55] ATOMIC ENERGY ACT OF 1946, Public Law 585, 79th Congress (1946).
[56] THE ATOMIC ENERGY ACT OF 1954, AS AMENDED, Public Law 83-703, 68 Stat. 919 (August 1954).
[57] U.S.NRC, History.
URL http://www.nrc.gov/about-nrc/history.html
[58] U.S.NRC, Nuclear Regulatory Legislation 111th Congress; 2nd Session, NUREG- 0980 Vol. 1, No. 9 (January 2011).
[59] World Nuclear Association, US Nuclear Power Policy.
URL http://www.world-nuclear.org/info/inf41_US_nuclear_power_policy.html
[60] U.S.NRC, How We Regulate.
URL http://www.nrc.gov/about-nrc/regulatory.html
[61] U.S.NRC, Report to Congress on the Security Inspection Program for Commercial Power Reactors and Category I Fuel Cycle Facilities: Results and Status Update - Annual Report for Calendar Year 2010, NUREG-1885 Rev. 4 (2010).
[62] U.S.NRC, Organization and Functions.
URL http://www.nrc.gov/about-nrc/organization.html
[63] U.S.DOE, History.
URL http://energy.gov/management/history
[64] U.S.NRC, Physical protection of plants and materials, 10 CFR part 73.
[65] U.S.NRC, Material control and accountancy of special nuclear material, 10 CFR part 74.
[66] U.S.NRC, Domestic licensing of production and utilization facilities – Emergency plans, 10 CRF part 50.47.
[67] U.S.NRC, Domestic licensing of production and utilization facilities – Emergency Planning and Preparedness for Production and Utilization Facilities, 10 CRF appendix E.
[68] U.S.NRC, Emergency Planning, NUREG-0800 part 13.3 rev. 3 (March 2007).
[69] U.S.NRC, Emergency Planning - Inspections, Tests, Analyses, and Acceptance Criteria, NUREG-0800 part 14.3.10 (March 2007).
[70] U.S.NRC - FEMA, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG-0654/FEMA-REP-1 rev. 1.
[71] U.S.NRC, Functional Criteria for Emergency Response Facilities, NUREG-0696 (February 1981).
[72] U.S.NRC, Clarification of TMI Action Plan Requirements: Requirements for Emergency Response Capabilitys, NUREG-0737.
[73] U.S.NRC, NRC Incident Response Plan, NUREG-0728 rev. 4 (April 2005).
[74] U.S.NRC, Emergency Preparedness in Response to Terrorism.
URL http://www.nrc.gov/about-nrc/emerg-preparedness/respond-to-emerg/response-terrorism.html#two

[75] U.S.NRC, Typical 10-Mile plume exposure pathways EPZ map. URL http://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/planning-zones/10-mile-plume-exposure.html