Chapter 17

The French National Perspective on Nuclear Non-proliferation

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As a permanent member of the United Nation Security Council and nuclear weapon state under the terms of the NPT, France has particular responsibilities for the preservation and the strengthening of international peace and security. Actions are conducted, in the first instance, through multilateral mechanisms. In this regard, France consistently supports efforts made to implement and reinforce, as appropriate, multilateral treaties and agreements on non-proliferation. France recognizes the strength of those multilateral treaties and agreements but considers that they are not sufficient. There is also a need for integrated and coordinated approach at national level, dedicated organization and a strong nuclear expertise. Any strategic decision in the nuclear field (program funding's, export policy, cooperation's...) is taken by a specific council, at the President level. Among all issues taken into account, non-proliferation is the central one. The CEA: the Atomic Energy Commission, the French government technical expert, is part of this specific Council. The CEA has developed a five steps methodology which takes its fuel and weapon cycles knowledge into account, in order to anticipate, assess, monitor and prevent the risk of proliferation. Ultra-trace sample analysis and satellite imagery are two key tools, as well as export control and bibliometry. Beside those capabilities, CEA has also supported MFA negotiators for E3/UE + 3 Iran deal, providing technical support for political decisions. CEA has also developed seismic and radionuclides capabilities for nuclear tests detection and characterization.

France consistently supports efforts made to implement and reinforce, as appropriate, multilateral treaties and agreements on non-proliferation. Even if France recognizes the strength of those multilateral treaties and agreements, there is also a need for an integrated and coordinated approach at national level, dedicated organization and a strong nuclear expertise to efficiently anticipate, assess, monitor and prevent the risk of proliferation. This paper describes the five steps methodology

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developed by CEA, focusing on specific tools like ultra-trace sample analysis, satellite imagery but also seismic and radionuclides capabilities for nuclear tests detection and characterization.

As a permanent member of the United Nation Security Council and nuclear weapon state under the terms of the NPT, France has particular responsibilities for the preservation and the strengthening of international peace and security. In this context, the French President stated in Istres, 19 February 2015: *“France has decided to fight against one of the major threats, the proliferation of massive destruction weapons. Any increase in the number of nuclear weapon states is a major risk for peace: not only in the regions around but also for international security.”*

Recently President Macron reiterated these commitments in the context of North Korea provocations. French action to combat proliferation and promote arms control and disarmament takes this dual responsibility fully into account. It is guided by a set of unchanging principles: the development of friendly relations between states; the prevention of threats to peace; respect for the right of self-defense; renunciation of the arms race and progress towards general and complete disarmament. France pursues these principles through multilateral mechanisms, legal regimes and, where necessary, ad hoc initiatives. In doing so, it takes into account developments in the international security situation and the evolving strategic context, while always seeking the broadest possible international consensus.

Actions are conducted, in the first instance, through multilateral mechanisms. In this regard, France consistently supports efforts made to implement and reinforce, as appropriate, multilateral treaties and agreements on nonproliferation. France supports in particular those multilateral institutions charged with the task of verifying compliance with such treaties and agreements. France also contributes fully across the spectrum of European initiatives in the fight against proliferation. France became party to the NPT on August 1992 and attaches particular importance to the central role of the IAEA's safeguards. France has signed and ratified the CTBT on April 1998 and supports the provisional technical secretariat (PTS) in its work to set up the verification regime. France is a member of the Nuclear Suppliers Group.

France recognizes the strength of multilateral treaties and agreements on non-proliferation and supports them. France also considers that they are not sufficient. In the past, countries who signed the NPT conducted clandestine activities. North Korea is an emblematic case. There is a need for integrated and coordinated approach at national level, dedicated organization and a strong nuclear expertise.

Any strategic decision in the nuclear field (program funding's, export policy, cooperation's...) is taken by a specific council, at the President level. Among all issues taken into account, non-proliferation is the central objective (as an example, the proliferation resistance of nuclear processes and plants). Beside the President, the council members are: The prime minister and different ministries, the SGDSN (National secretariat for national defense and security) as well as the CEA: the Atomic Energy Commission, the French government technical expert.

This methodology is based on a five steps approach (see Figs. 17.1 and 17.2). The Atomic Energy Commission uses its fuel and weapon cycles precise knowledge to identify which are the indicators and signatures for the different steps of the cycles: ore extraction and uranium concentration, uranium conversion. Then, for the plutonium path, fuel manufacturing, reactor irradiation and plutonium extraction from reprocessing and, for uranium path, uranium enrichment and uranium metal manufacturing. Finally, high explosives, physics, detonics for device manufacturing and weaponization. This gives the opportunity to identify which kind of sensors devoted to those indicators and signatures detection could be needed. Those sensors could be highly sensitive detectors but can also be based on export control or visas identification. Then, CEA goes to data fusion including open sources and intelligence.

CEA is part of the NWAL (Network of Analytical laboratories, see Fig. 17.3). The French laboratory is, like the United States, Russian and Japanese laboratories, certified by the International Atomic Energy Agency (IAEA), both for particulate analysis and bulk plutonium and uranium analysis. France obtained this certification in 2000.

The French laboratory has performance in the femtogram range for plutonium.

Also, France has advanced capabilities in the field of satellite imagery (see Fig. 17.4), both for optical, infrared, radar and hyperspectral techniques. Satellite imagery plays a key role in the detection and characterization of plants, facilities and site. It gives information related to the stages of construction, the starting of operations and the monitoring of ongoing activities.

Fig. 17.1 The atomic energy commission methodology for country nuclear program assessment

Fig. 17.2 Nuclear materials and weapons development scheme

Fig. 17.3 Sample analysis to support the IAEA (NWL) since 2000

In the field of export control, there is a clear need for a national organization where all national agencies are involved. In France, about ten agencies, all together takes part in the weekly instruction of demands, under the supervision of the SBDU which is: “Service des Biens à Double Usage”. About 50 to 80 demands are examined every week. At national level, monthly decisions for export are taken by the CIBDU which is the: “Commission Interministérielle des Biens à Double

Fig. 17.4 The key role of satellite imagery

usage”. The atomic energy Commission also provides sensibilisation for the private companies. Many meetings are held in order to inform about the risks. France also considers that there is a need for International cooperation.

The methodology described above has been implemented in France for many decades. It has been reinforced in 2010 when SBDU and CIBDU were created.

France considers that bibliometry (see Fig. 17.5) is a very efficient tool for scientific investigation. It gives the opportunity to identify topics of interest, collaboration networks, change with time of the topics of interest, check information from various sources, detect training centers and evaluate the potential of a country. This way, one can constitute a knowledge catalogue.

Starting from October 2013, the CEA supported the French MFA negotiators for the interim deal (JPOA, Joint Plan of Action). Then, in April 2015, the CEA contributed to the definition of the key parameters for the Joint Comprehensive Plan of Action (JCPOA), related to Natanz, Fordo, Arak, reprocessing, and the civil nuclear cooperation. The JCPOA was agreed in Vienna, the 14 July 2015 and implemented the 16 January 2016 (Fig. 17.6).

More precisely, the CEA technical support for political decisions dealt with the uranium enrichment processes in Natanz and Fordo, the cascade configuration definition, the number of machines needed, the infrastructure definition and the break-out time calculation. On enrichment R&D, advanced centrifuge performance were evaluated and advanced centrifuge program phasing was precisely defined. Also, low enriched uranium stockpiles for a 12 months break out time, taking 3.67 and 19.75% stocks limitations into account were quantified. With respect to Arak reactor redesign, the reactor configuration for plutonium production limitations was described and regarding section T of JCPOA, the prohibition measures for the

Fig. 17.5 A tool that helps: the bibliometry on scientific and technical literature

Fig. 17.6 CEA support to French MFA negotiators for E3/UE + 3 Iran deal: starting from JPOA to implementation and surveillance of JCPOA

development of a nuclear device were identified: metallurgy, computer codes, multi-point explosive detonation systems, diagnostic systems and neutron sources.

The first phase of the methodology for nuclear test monitoring is based, first, on pre-event monitoring, using intelligence information, open source and satellite imagery. The detection of a nuclear test uses national technical means but also

incorporate CTBT (see Fig. 17.7) and other raw data on selected stations. To locate and identify if it is an explosion or an earthquake, other stations of interest are incorporated and satellite images (pre and post event) are acquired if necessary. Then, to characterize the magnitude, depth and yield, available data (seismic, imagery ...) are fused. Finally, radionuclide data are used to assess the nuclear nature of the event.

Figure 17.8 compares two waveform spectra registered from 2016 and 2017 nuclear tests carried out by North Korea. This comparison helps for rapid and robust seismic detection, characterization, depth determination, yield estimation and assessment of DPRK’s statement There are large uncertainties on the North Korean nuclear weapons program. The nuclear material used, uranium or plutonium, is still unknown, as well as the nature of the device, even if Kim Jong-un claimed (see Fig. 17.9) that a thermonuclear device was tested on September 3 2017.

Fig. 17.7 CTBT stations operated by France

Fig. 17.8 DPRK nuclear tests comparison: detection and characterization

Fig. 17.9 Kim Jong-un

Taking the history of proliferation into account, in particular the current North Korea case, it appears that, to efficiently fight against proliferation, there is a clear need for better anticipation to avoid « le fait accompli » .. Stronger evaluation of the real status of the country's nuclear programs and their real capabilities is needed as well as a more efficient monitoring. Diplomatic action and negotiation, whenever it is possible and as soon as possible, is key and international cooperation, that gives the opportunity to share validated information, is needed. The best nuclear expertise (fuel and weapon cycles knowledge, development of highly sensitive sensors....) is also key. Finally, it is important to stress the central role of the IAEA inspections.

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