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**IMPLEMENTING A TABLE TOP EXERCISE (TTX)**

**FOR ASSESSING PHYSICAL PROTECTION SYSTEM**

**EFFICIENCY AT NATIONAL CENTRE FOR**

**SCIENTIFIC RESEARCH “DEMOKRITOS”**

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**Abstract**

The paper describes the conduction of a table top exercise at the premises of N.C.S.R. “Demokritos”, in order to examine the efficiency of the Physical Protection System (PPS) against external adversaries. The work is part of the activities of the group of authors within the framework of the IAEA CRP J02006 “Enhance the Effectiveness of Nuclear Security at Research Reactor and Associated Facilities” and in particular Task 1 that assessed methodologies developed by the NU.S.A.M. CRP as applied to RRAFs. Task 1 objective was to evaluate NU.S.A.M. by applying it on Hypothetical Atomic Research Institute (HARI) through the implementation of two Table Top exercises. Further on, the discussed tools should be used for PPS evaluation at participant’s facilities.

1. INTRODUCTION

**1.1. Objectives**

The objectives of the TTX were 3-fold:

• Evaluate the performance of the current PPS and the Security Emergency Procedures of the facility, under a specific threat, and determine its Weak Points and Vulnerabilities.

• Evaluate the implementation of Security Procedures and the Response Tactics by Security Personnel during an Emergency Scenario that included external threats.

• Contribute to the continuous training of Security Personnel at N.C.S.R. Demokritos.

**1.2. Scope**

The organizing team of the TTX decided that participants were exclusively members of N.C.S.R. “Demokritos” Security Personnel. The reason for such a decision was that the organizers wanted the security personnel participating in the workshop to feel comfortable implementing the security procedures during an emergency event, without the presence of external responders (Police First Responders, Swat Team, Fire Brigade, Ambulance Service), and mainly to comment and criticize, unbiased, the outcome and the procedures of the exercise. The readiness degree and the cooperation with external responders during a malicious event will be examined in a future workshop.

For the implementation of the TTX, the Sandia National Laboratories Methodology, as described in NUSAM CRP [1], was used. The TTX took place in 2 daily workshops in order that security personnel working at night shifts had the ability to attend.

**1.3. TTX Preparation**

For the appropriate preparation of the exercise the following data and documentations was gathered: PPS Performance Tests, Barrier Delay times [2], Assessment and Communication times [2], Guards and External Response Forces times, Design Basis Threat (DBT) scenarios, Contingency Plans.

For the organization of the TTX, various maps with different scales we used, tokens with appropriate colors for Adversary and Response Teams, 10sided dices for the determination of engagements outcome, white boards and flipcharts for scribing adversaries’ and response’s teams movements and time frames.

**1.4. Roles and Responsibilities**

Participants were assigned 6 key roles and responsibilities for the conduct of the exercise:

* **Facilitator.** A person with responsibilities to facilitate the exercise and to ensure an accurate and unbiased outcome of the simulation. Assures all parties act in accordance with the agreed rules. The facilitator has final decision making authority when parties do not agree on an issue. Records all movements and engagements outcome.
* **Protective Force Team** **(Blue Team).** Determines the initial positions for each response element as well as managing all response actions and reactions during the simulation according to contingency plans, training, and tactics.
* **Adversary Team** **(Red Team).** Determines the initial positions for each adversary unit as well as managing all adversary actions and reactions during the simulation according the original attack plan.
* **Evaluation Team (Green Team).**  Team serves as an unbiased referee or judge. Provides input to the Facilitator to determine results of security events and engagements. Defines practical PPS design capabilities like effectiveness of detection, assessment and delay components, communication protocols and resolves conflicts between Protective Force and Adversary teams.
* **Protective Force Team Coordinator.** Reassures that Blue Team actions and reactions are conducted according to contingency plans, training, and tactics and is responsible to communicate team’s decisions to facilitator.
* **Adversary Team Coordinator.** Reassures that Red Team actions and reactions are conducted according to attack plans and is responsible to communicate team’s decisions to facilitator.

Members of the organizing team assigned the roles of Facilitator, Evaluation team and the two coordinators.

1. TTX IMPLEMENTATION

**2.1. Setting up the TTX**

Prior the beginning of the exercise a member of the organizing team made a Power Point presentation where all the necessary clarifications were made, e.g. TTX scenario and parameters, number of Adversaries and Protective Forces, weapons and equipment at adversaries disposal, vehicles, look up tables, TTX end conditions, External Responses time, time increments per round, time given for both teams to execute their attack/defensive plans.

After this briefing the Security Personnel was divided in Red and Blue teams and the Red team with its coordinator was transferred to different room to design their attack plan within 20 minutes. This approach prohibits participants from having a “God’s View” which will influence their command and control actions.

During the same time, Blue team would design their protective positions according the attack scenario.

The sequence of moves per round begins with Adversaries announcing their first move to Facilitator who scribes it and places the appropriate tokens on the scaled map, at Red team’s room. Facilitator also documents all the Red team’s tokens, their weapons and the tools they are currying and the vehicles position as well.

Then Protective Forces announce their move to the Facilitator, which is scribed also and the appropriate tokens are placed in the scaled map, at Blue team’s room.

The two teams would keep separate until the first engagement.

In case of engagement between the teams, the Ph/Pk, Sandia N.L. probability charts were used, TABLES 1 & 2 [1]

TABLE 1. SNL TTX PH CHART FOR HUMAN TARGETS



TABLE 2. SNL TTX PH CHART FOR ARMOURED VEHICLES



As presented in the above Tables, factors like weapon type, range and rounds fired in accordance with 10sided dices were used, to determine a probability based outcome. Based on the number of rounds fired, the number of dice was thrown. The result of 7 or lower per dice was a kill; 8-9-10 was a miss.

Scenarios were different per each day. The first day, the Scenario chosen was Sabotage in Reactor Pool, while the second day scenario chosen was Theft of Radioactive Source Stored in Reactor’s Ground Level.

End Conditions of TTX were predefined as the following: Red team achieved their goal; Red team could not achieve their goal due the lack of enough members to complete task; Loss of essential equipment to complete task (explosives, tools, and vehicles); when Police Responders arrive on site.

Total TTX duration time per day was estimated at 5 hours.

**2.2. First Scenario:** **Sabotage in Reactor Pool**

According to this scenario the Red Team was manned by 4 persons with military skills, currying radios and they were armed with AK-47, 9 mm Pistol, Sniper Rifle (7.62), Hook gun, 10kg TNT explosives, and they were equipped with Oxygen cutting torch, and 50m rope. They were using a 4X4 vehicle. The have the assist of a passive insider.

The Blue Team was manned by 5 persons in guarding and patrolling positions, they were unarmed and they were currying torches and radios. They had a patrol vehicle in their disposal and they were following everyday procedures. They were urged to foster realistic (no heroes) approach.

The Scenario parameters (common for both scenarios) were: February, 02:30 am, rainy weather, Temperature 3⁰C, North Wind 5 Beaufort wind force scale, and Police Responders time was calculated at 6 min. after duress button was activated by guards.

Time increments per round were played at 10 sec. intervals.

Between rounds, 5 min. time was given to each team to prepare their next moves.

*2.2.1. TTX Result*

The TTX’s real time was 7 min. The Adversaries achieved their goal to Sabotage Reactor Pool.

They were detected by the PPS in 3 min. 20 sec, TTX real time.

Police Responders estimated arrival time was 2 min. and 20 sec after Adversaries achieved their goal.

*2.2.2. ΤΤΧ’s ‘Hot’ Evaluation*

Upon finishing the exercise, the organizing team started a conversation between all participants and asked them to express unbiased their thoughts and feelings about their experience. The feedback shared was very positive. The majority commended that it was a very useful practice over emergency procedures and tactics, for recognizing the vulnerable points of the PPS and thus to pay enhanced attention to them. Also, they proposed compensatory actions, to eliminate those vulnerabilities, focusing in procedures, equipment and sensors. They underlined the importance of an early detection in the overall PPS performance, and its significance to prevent malicious acts. They understood their duty of being vigilant and the importance implementing procedures by the book.

**2.3. Second Scenario: Theft of Radioactive Source Stored in Reactor’s Ground Level**

According to this Scenario the Red Team was manned by 5 persons with military skills, carrying radios and they were armed with AK-47, 9mm Pistol, Sniper Rifle (7.62), RPG, 10kg TNT explosives. They were using a van and a motorcycle. The have the assist of a passive insider.

The Blue Team was manned with 6 persons (being on Enhanced Security Level due Intelligence information). One more single walking patrolman was added to the shift. They were unarmed and they were currying torches and radios. They had a patrol vehicle in their disposal and they were following everyday procedures.

The Scenario parameters were: February, 02:30 am, rainy weather, Temperature 3⁰C, North Wind 5 Beaufort wind force scale, and Police Responders time was calculated at 6 min. after duress button was activated by guards.

Radioactive Source was placed in Reactor’s Ground Level, inside a shield container, weighed 30kgr.

Time increments per round were played at 15 sec. intervals.

Between rounds, 5 min. time was given to each team to prepare their next moves.

*2.3.1. TTX Result*

The Red Team aborted their plan due to a very early detection by patrolmen. Detection took place at 30 sec. TTX real time.

Police was informed at 45 sec. TTX real time

Total TTX’s real time was only 1min 15 sec.

The excellent dispersion of the Blue Team was the reason for timely detection.

*2.3.2. ΤΤΧ’s ‘Hot’ Evaluation*

The organizing team took advantage the short duration of the exercise and started a thorough conversation with the participants of both teams. Their feedback was a very positive one, and they commended practically the same things their fellow workers did during the previous TTX.

One of the things they specially focused was updating procedures and they mentioned certain interesting ideas, they considered important to be embodied in the current procedures.

Another important outcome was their remark that a TTX is a great tool to build up ‘team spirit’ between Security Personnel, by understanding that they belong to a special group, with unique characteristics and they are interdependent between each other.

1. CONCLUSIONS

The organizing team had a positive feedback from conducting the two daily workshops. Participants showed a great interest implementing the various scenarios. Using their valuable experience and expertise, they found the most vulnerable attacking path fulfilling their goal to Sabotage the Reactor Pool. In the second scenario, they dispersed Protective Forces ideally, preventing Adversaries to achieve their goal and thus to abort the attack.

Supervising both exercises they had the chance to recognize the vulnerable paths of PPS and to consider the corrective actions remedying those vulnerabilities.

It was a fine training exercise for Security Personnel to repeat, evaluate and familiarize with Site’s Emergency procedures confronting a malicious attack.

Also many new approaches concerning procedures update were addressed during discussions. That was a fine opportunity for Security Personnel to share their valuable opinions and comments for the overall enhancement of the PPS.

Additionally, it was understood that a TTX is a cost effective tool, permitting frequent implementation without imposing financial burden to Facilities.

1. LESSONS LEARNED

Having this experience, the organizing team feels the need to share some critical points that can influence negatively the TTX process.

-Facilitator has a vital role for the smooth evolution of the exercise. Must always have control over Adversaries and Response Force Teams, and reassure that their scenarios planning are within prearranged limits. Keeping predefined time is crucial for TTX timely completion.

-Team coordinators have an equally important role for controlling two teams from the very beginning of their plans. Special attention must be given so the coordinators should remain neutral and not interfere sentimentally with their teams and help their planning.

-Evaluation Team should have the knowledge and the experience of using look up tables for resolving expected disputes. They must remain unbiased and always ready to consult Facilitator, especially when he/she experiencing criticism by the two team members.

-Look up Tables are absolutely essential for properly conducting a TTX. They should be updated with all necessary data (penetration times, barriers delays, cameras data, moving times, explosives capacity, weapons ranges etc.).

- TTX proved useful; however in order to have the maximum assessing impact on the PPS, the above mentioned Look up Tables should be advised in accordance with Site’s PPS specific Performance Test Data, otherwise analysis would be difficult.

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[2] IAEA, Data Book of RTC on Physical Protection on Nuclear Material and Nuclear Facilities, Delft, The Netherlands, 23 May - 3 June 2016.

**ABBREVIATIONS**

CRP Coordinated research project

DBT Design basis threat

HARI Hypothetical Atomic Research Institute

IAEA International Atomic Energy Agency

KIA Killed in action

NM Nuclear material

NUSAM Nuclear security assessment methodologies

PH/PK Probability hit/probability kill

PPS Physical protection system

PRT PPS response time

RRAF Research Reactors & Associated Facilities

RF Response force

SNL Sandia National Laboratories

TTX Table Top Exercise

TTX Real Time, Exercise’s Actual Time