Integrated Test Range, Defence Research & Development Organization

Chandipur, Odisha (756025)

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Report On Orientation Programme For Batch-I

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Introduction:- The **DRDO** is an agency of the Government of India, charged with the military's research and development, headquartered in New Delhi, India. It was formed in 1958 by the merger of the Technical Development Establishment and the Directorate of Technical Development and Production with the Defence Science Organisation. It is under the administrative control of the Ministry of Defence, Government of India.

DRDO is working in various areas of military technology, which include aeronautics, armaments, combat vehicles, electronics, instrumentation engineering systems, missiles, materials, naval systems, advanced computing, simulation and life sciences. **DRDO** while striving to meet the Cutting edge weapons technology requirements provides ample spinoff benefits to the society at large thereby contributing to the nation building and make India prosperous by establishing world-class science and technology base and provide our Defence Services decisive edge by equipping them with internationally competitive systems and solutions.

Integrated Test Range was set up to provide safe and reliable launch facility for performance evaluation of Rockets, Missiles and Air Borne Weapons Systems. Starting in 1982, as a project under Integrated Guided Missile Development Programme (IGMDP), it has graduated to perfection over the years and has reached the status of World Class Test Range. To be a trusted integrated test facility, delivering reliable and quality service to all customers.

ITR, Chandipur strategically located along the Bay of Bengal, it has the advantage of safe corridor for short and medium range missile systems. The receding sea of Chandipur serves as a God-gifted test-bed for weapons.

Missile & Test Range:- Any object through at a target with air of hitting, it is a Missile.

Types of missile-

Based on the type of trajectory-

- Cruise Missile- A cruise missile is a guided missile used against terrestrial targets, that remains in the atmosphere and flies the major portion of its flight path at approximately constant speed. Cruise missiles are designed to deliver a large warhead over long distances with high precision. Modern cruise missiles are capable of travelling at supersonic or high subsonic speeds, are self-navigating, and are able to fly on a non-ballistic, extremely low-altitude trajectory.
- Ballistic Missile- A ballistic missile follows a ballistic trajectory to deliver one or more warheads on a predetermined target. These weapons are only guided during relatively brief periods of flight—most of their trajectory is unpowered, being governed by gravity and air resistance if in the atmosphere. Shorter range ballistic missiles stay within the Earth's atmosphere, while longer-ranged intercontinental ballistic missiles (ICBMs), are launched on a sub-orbital flight trajectory and spend most of their flight out of the atmosphere.

Based on launch platform and target-

- Surface to surface
- Surface to air

- Air to air
- Air to surface

The major components of a missile-

- Airframe
- Propulsion System
- Flight control system
- Guidance system
- Warhead.

Target System For Test & Evaluation:-

Sensor- The sensor is a device, that senses a physical quantity and converts it into an analogue quantity which can be measured electrically such as voltage, capacitance, inductance and ohmic resistance.

Transducer- The transducer is a device that is connected to sensor to convert the measured quantity into a standard electrical signal. The o/p of the transducer can be directly used by the system designer.

Test against Target-

- Head on target
- Tail chasing target

Unmanned Armed Vehicle- An UAV is an aircraft without human pilot. It uses aerodynamic forces to provide vehicle lift, can be expandable or recoverable.

Radar Cross Section (RCS):-

$$RCS = \frac{4*Pi*r^2*Sr}{St}$$

Where,

Pi = 3.14159

r = radar range

Sr =Scattered power density (W/m^2)

St =Power density intercepted by target (W/m^2)

Telemetry System:- It means remote measurement. It is used to make measurement at inaccessible or inconvenient or unsafe locations; like unmanned aircraft, nuclear reactor and space borne system for human beings and present in a remote location.

Line Coding:- Line coding is the process of transforming logic bits to voltage levels using physical waveforms. Two familiar of codes are recommend by IRIG- Non-Return to Zero, Biphase(A kind of Manchester code).

Distortion:- Distortion is change in the shape of the signal due to noise.

Attenuation:- Attenuation is reduction in power of a signal.

Electro Optics Tracking System (EOTS):- An Electro-Optical Targeting System (EOTS), is a system employed to track and locate targets in aerial warfare. It can use charge-coupled device TV cameras, laser rangefinders and laser designators.

Operational requirements on an EOTS tracking system are-

- Target detection
- Target auto-track
- Data collection
- Real-time data reduction.

EOTS usually consist of an imaging sensor, gimbal assembly, video tracker and control system which acquires and maintains a selected target in the sensor field-of-view.

Campus Area Network (CAN):- ITR has a well established CAN to maintain communication between the different launch complexes stationed at 4 locations for different ranges (short as well as long), sites and divisions.The basic objective of the CAN is to render paperless services and faster communication between different divisions with minimum time lag.

Services of CAN:

- Employee Information System
- Leave Management System
- DO Part Management
- Finance Management
- Online Video Lectures
- Library Management
- Mailing services
- IMMG System

To well establish a CAN, the hardware and software requirements are as follows:

Hardware:

1.) Blade Service

2.) Network Switch and Router

3.) Tape Library

4.) Fiber Optic Backbone for 10G Connectivity

Software:

1.) Exchange Mail

2.) Lync Server (For Video Calling Services)

3.) Everest NMS (Network Management Software)

4.) Oracle (Data-base Management Software)

Similar to CAN, a private Intranet called DRONA is established to maintain communication between the various establishments of DRDO all over India.

Power System in Range:- There are various power sources working in the range which provide **uninterrupted** power supply to the various divisions operating in the range.

Basically, they are:

Diesel based Generators (driven by IC Engines utilizing diesel combustion as a fuel)

Solar Panels (A renewable, non-polluting source)

The whole campus, like any other establishment requires an uninterrupted power supply for its efficient working. For this, there is a need for protection against :

a) Transients or sudden spike in current or voltages

b) Frequency variations

c) Voltage Sag

d) Voltage Surge

The above factors are the most contributing for the interruption of normal working and fault of the power system. So, there is a **Power Monitoring System** to analyze the real time status of the power related parameters of the system which include:

a) Power Analyzer

b) Event Logger

c) Multimeter

d) Clamp Meter

For power storage there is a need for **Battery** and efficient **Converters** for use of electricity during fault situations and absence of power from established infrastructure.

Types of Batteries:

1) Flooded Lead Acid Battery

2) Tubular Lead Acid Battery

3) SMF Lead Acid Battery

4) Gel Lead Battery (Silica based)

5) Lithium ion Battery

Protection System: For assurance of normal running conditions and for protection of user, there are **Circuit Breakers**, **Lightning Protection** Systems and **Grounding** systems operating in the range.

Circuit breakers are of various types as follows:

Miniature Circuit Breakers:

Type A, Type B, Type C, Type D

Moulded Case Circuit Breakers (MCCB): Range is higher with respect to that of MCB.

Earth Leakage Circuit Breaker: To prevent shock or damage to human using appliances.

Mission Coordination:- There are 4 parts of mission co-ordination which include:

a) Pre-Flight

b) On-flight

c) Post-flight

d) Non-Mission

Generally, it involves the following :

a) Receipt of data for range requirement

b) Allotment of range

c) Receipt of data for Project:

- Flight Test Plan
- Nominal Trajectory

d) Discussion of Joint Co-ordination Committee regarding launch

e) Helicopter Sortie (Non- mission) and Link checks

f) Conduct of Range Integration checks

g) Display validation

h) Test and Evaluation

Then, occurs conduct of launch.

Then, follows Post Mission Analysis in which :

a) Collection of data is done from various sensors and radars.

b) Conduct of PMA is done.

c) Customer feedback is taken.

Hence, the above sequence of procedures is followed during a mission to ensure safe and proper coordination and carry out of a successful mission.

Range Communication System:- For proper tracking of a flight, three parameters are required to locate a projectile in space which is basically acquired through a communication system of **Radars and EOTS .** These parameters are: **Azimuth, Look angle and Range.**

The monitoring of on board parameters, viz. temperature, pressure, vibrations etc. is done through **Telemetry** system.

Two modes of **Tracking through RADAR** are:

a) Skin Mode of tracking: The time interval between transmission and reception of a pulse is utilized to calculate the position of a flight.

b)Transponder based tracking: Electronics onboard are utilized to transmit back signals on reception from earth based antennae.

EOTS: The major contribution of EOTS system is it helps in tracking during take on and take off conditions. It can help in starting the timer during flight tracking.

The various nodes of the network are connected through fiber optic cables as well as satellite links to establish a redundant link to provide alternate routes for communication if one route fails.

Positional advantage of Nilgiri Hills in the range communication system: The presence of a high hill for installing a Radar system for flight tracking gives the natural advantage of a long Line Of Sight distance.

Need of Real Time Communication: The need of real time communication is to work with minimum time delay in a mission which poses risk of huge loss if there is no instantaneous response from the concerned authorities. **Circuit switching and packet switching** technologies are deployed for real time and non real-time communication.

The satellites from Inmarsat (group of commercial satellites) are used for communicating the data from central computers to the stationed ships in the deep Indian Ocean for target acquisition.

Computer Data Processing:- Data processing, Manipulation of data by a computer. It includes the conversion of raw data to machine-readable form, flow of data through the CPU and

memory to output devices, and formatting or transformation of output. Any use of computers to perform defined operations on data can be included under data processing. In the commercial world, data processing refers to the processing of data required to run organizations and businesses.

Components involved in data processing-

- Central Processing Unit(CPU)
- Memory (RAM & ROM)
- Data Bus
- Ports
- Motherboard
- Hard disk
- Input devices
- Output device.

Range Instrumentation Radar:-

RADAR stands for Radio Direction and Ranging.

Frequency bands used by the RADARs in the range are in the S-band, C-band and X-Band ranging over frequencies of (2-6) GHz. Ultra High Frequencies are used so that the antennae Size is practically realizable.

Basically, 2 modes of tracking are used which are:

a) Skin based: depends on the rays reflected by the missile to track it.

b) Transponder based: Electronic circuits are deployed in the missile to transmit signals to the RADAR.

For tracking highly manoeuvring targets, beams are focused by using **switching antennae** and **simultaneous lobing technologies.**

One issue which arises while calculating position of missile is determining the exact timing difference of received and transmitted pulses which is termed as Resolution error. The data are calculated while optimizing the errors.

Single/Multiple Target Tracking System: For multiple target tracking system, one part of the transmitter arrays are used to track one interceptor missile and another part is used for tracking another missile.

RADAR Sub System: The sub system basically involves:

a) Transmitter, b) Duplexer, c) Antennae, d) Signal Processor, e) Receiver.

The signals received are transmitted to the display in the control center.

Range & Flight Safety:-

Range Safety:-

- Facility for flight-testing of weapon systems.
- Sensor base for tracking and telemetry.
- Provision of communication, command and safety to the user of the range.

Flight Safety:-

- Notification of range volume.
- Flight termination in adverse situation.

Telecommand System:- It involves generation and transmission of signal. A Telecommand is a command sent to control a remote system or systems not directly connected (e.g. via wires) to the place from which the Telecommand is sent. The Telecommand can be done in real time or not depending on the circumstances.

Environmental Safety:- Environmental safety is the practice of policies and procedures that ensure that a surrounding environment, including work areas, laboratories or facilities, is free of dangers that could cause harm to a person working in those areas. A safe place to work is the key element of environmental safety.

Thanking You!!
