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Classification: Unclassified

From: 23 Wing
Subject: Class C, Final, Directed Energy, Directed Energy Weapon, Directed Energy Weapon/null

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1. General Information:
1.1. AFSAS Report Number: 461659
1.2. Unit Control Number: --
1.3. Convening Authority: 23 Wing
1.4. Accounting MAJCOM, DRU or FOA: Air Combat Command
1.5. Accounting NAF: Ninth Air Force
1.6. Accounting Wing: 23 Wing
1.7. Accounting Group: 820 Security Forces Group
1.8. Accounting Base: Moody AFB GA
1.9. Accounting Office Symbol: --
1.10. Mishap Duty Status: On-Duty
1.11. Mishap Type:
1.11.1. Tier 1: Beam Control
1.11.2. Tier 2: Other, Describe: Overexposure to beam

2. Mishap Date/Time:
2.1. Mishap Date, Local: 04 APR 2007
2.2. Mishap Time, Local: 1840

3. Mishap Location:
3.1. Location Description: Grand Bay Aerial Bombing Range
3.2. Mishap Country: United States (USA)
3.3. Mishap State: Georgia
3.4. Nearest Base: Moody AFB GA
3.5. Latitude: --
3.6. Longitude: --
4. Narrative:

On 4 April 2007, at 1520 local, the Security Force Group (SFG) NCOIC of the Advance Technology Section also the acting Active Denial System 1 (ADS) Crew Commander for the Extended User Evaluation (EUE) exercise (AFSAS Person 1, P1), directed his team to remove the ADS from life support, prepare it, and drive it to the base aerial bombing and gunnery range for operational use in an EUE exercise. The Crew Commander (P1), trained by ADRL ADS ACTD at Kirkland AFB and ADS Operator being locally trained (AFSAS Person 2, P2) drove the ADS to the SFG headquarters, BLDG 1530, to retrieve programmed radios for that day's EUE exercise.

The Crew Commander (P1) and ADS Operator (P2) were met on the range by an experienced ADS operator, person 4 (P4), along with 23 other military members and one civilian contract observer/evaluator from the AF Battle Lab. After all exercise members and observers signed into the range at the Range Control Office, they proceeded to the pre-selected exercise area on the range. The Crew Commander (P1), ADS Operators (P2 and P4) met with the SFG NCOIC of Standardization and Evaluation Section (STAN EVAL) for an exercise overview and safety briefing. The team was broken down into the Blue Forces (friendly) and Red Forces (opposing) and were briefed about proper procedures on how to signal the ADS Operator that they were done being fired upon. The signal was to raise both arms and hands in the air above the head or take a prone position on the ground. STAN EVAL briefed the plan for that day's exercise to be three scenarios with two iterations each for a total of 6 events. There was no prior discussion among the ADS Crew (P1, P2, and P4) as to the correlation of each scenario's range to target and system settings. Each ADS Operator was left to his own understanding and experience to determine ADS settings. The ADS Crew (P1, P2, and P4) positioned and setup the ADS to include "dummy shots" and "warm up shots" with no personnel down range from the system. After the system was ready exercise members took their positions for the first iteration of scenario 1.

In scenario 1, first iteration, event 1, the ADS was setup close to a mock entry control point (ECP) with the Red Forces resembling a crowd of people approaching head on into the ADS. Before event 1 began the Crew Commander (P1) and ADS Operator (P4), quickly determined that the ADS needed to be moved further away from the ECP to be effective. Scenario 1, first iteration, event 1, began at 1710, with the ADS further from the ECP and the Red Forces departing parallel to and away from the ADS towards the ECP. Scenario 1's second iteration, event 2 started at 1727 and ended at 1730. Both iterations of scenario 1 were completed with few minor ADS faults challenging the crew to clear and keep the ADS operational. There were no unexpected reactions or unusual after effects reported by Red Force personnel to the unit physician assistant (PA) on scene. The ADS Operator (P4) was able to achieve the objective using mostly a system setting of 75% power at a 3 second duration. The minor faults the ADS experienced were due to the "magnetic field not reached"; this was caused by radio interference. All faults were cleared during the scenario events. The Crew Commander (P1) identified that the temperature in the bed of the ADS vehicle was rising. Both Red and Blue Forces took a 10 minute break before beginning scenario 2. The Crew Commander (P1) removed panels from the ADS to facilitate better air flow for cooling. Approaching scenario 2 the ADS crew (P1 and P4) discussed ways to avoid the radio interference between them and Blue Force commander. It was decided to use the radios in brief transmissions to relay critical information only.

Scenario 2 required the ADS crew (P1 and P4) to respond to Blue Force Commander's attempt to spot and deter Red Forces setting up an improvised explosive device at a very far distance. ADS Operator (P4) set power to 100% for 4 second duration, so as to be effective at the longer range. Scenario 2, first iteration, event 3, began at 1751 and the same ADS faults were experienced during the event as were in scenario 1. The Crew Commander
(P1) and ADS Operator (P4) were able to achieve the objective and the event was ended. No reports of any unusual bio-effects or after effects reported to PA. For the second iteration of scenario 2, event 4, the Crew Commander (P1) decided to replace ADS Operator (P4) with ADS Operator (P2). ADS Operator (P2) was locally trained and had not yet fired on human targets with the ADS. ADS Operator (P4) went down range to video tape the remaining events. Scenario 2, second iteration, event 4, began at about 1807, with the ADS system experiencing problems due to the heat build up and subsequent compressor shut downs on the cooling system. The Crew Commander (P1) continued to troubleshoot the system while the ADS Operator (P2) attempted to fire the ADS. The ADS crew (P1 and P2) received numerous "Gun Not Ready: Gun Coil" faults and could not clear the system. The ADS crew (P1 and P2) had to disengage event 4 to allow the ADS to recover. The Crew Commander (P1) consulted with ADS Operator (P4) and decided that the system should be brought down to "pre-mission mode" to clear the persistent fault. The ADS crew (P1, P2 and P4) brought the ADS system back up to "stand-by mode" waited 3 minutes and then brought it up to "arm mode." By that point in time STAN EVAL decided, in consultation with a Security Forces Squadron commander who was an acting role player in the Red Forces team (AFSAS person three, P3), to terminate scenario 2, second iteration, event 4, at about 1810 and move on to the final scenario. The ADS did not fire a single shot in event 4.

When the ADS system came back up into "stand-by mode" it retained the previous settings of 100% at 4 seconds. Scenario 3, first iteration, event 5, began at 1840 with the Red Forces much closer than scenario 2. The role of the Red Forces was to collect surveillance data of the "Forward Operating Base." The Crew Commander (P1) conveyed target selection data received from the Blue Forces commander to ADS Operator (P2). The ADS Operator (P2) selected the first target using the in-line camera display and fired at his first human target with 100% power for about 4 seconds. Red Forces Role Player (P3) immediately knew that he had received a stronger than usual shot from the ADS; he gave the quit signal and left the field. Other Red Forces members continued the scenario and upon being shot only once this time also quit and left the field. With dusk approaching and needing to clear the range STAN EVAL terminated the EUE range activity and all proceeded back to the SFG headquarters, BLDG 1530, for debrief of the days events.

During the stand down the PA noticed that several members were continuing to report heat effects from the last event and Red Forces Role Player (P3) was becoming very uncomfortable. Back at the SFG HQ the PA surveyed all players and 4 individual appeared to have first degree burns and one, Role Player (P3), appeared to be blistering and in much worse condition than the other four role players with burns. It was decide by the PA to take Role Player (P3) downtown to the local area hospital emergency room. There the hospital staff decided, based on the type of exposure, the area of coverage, and severity, that Role Player (P3) should be flown to a burn center in Augusta, Georgia. The ADS was driven back to its maintenance bay and placed on life support power. On 5 April 07, the WG/SE was notified of the mishap and immediately impounded the system and collected statements from ADS crew, EUE organizers, observers, and role players.

INITIAL INVESTIGATION ACTIONS
WG/SE requested subject matter experts to assist in conducting the investigation analysis. One member from the AFRL/DEHA arrived 6 April 07, to capture flash memory from the ADS to assist in the investigation. A team of subject matter experts (SMEs) from the AFRL ADS ACTD arrived 11 April and received an in brief and review of known facts. It was determined by the 23 MDG Bio-Environmental personnel and the SMEs that it was imperative to determine the actual exposure produced by the ADS. Since the ADS firing log was not annotated for each ADS firing and the inside cabin camera was not turned on the data needed for calculating exposure was not captured. An actual firing and test was required of the ADS in the same location as the mishap. Arrangements were made on the range, some key players, and ADS Crew members were brought out to
The ADS was tested by placing a Carbon Loaded Teflon target in the relative location of where Role Player (P3) was exposed. The test revealed that at that distance, power, and duration the type of bio-effects apparent with P3's injuries would be expected. P3 was overexposed in excess of the 12 J/cm² limit for a moving target. The injured Red Force players were well inside the Fresnel maximum.

**INVESTIGATION ANALYSIS:**

- ADS Crew Commander did not conduct the system diagnostic IAW the unit's Active Denial System (ADS) Training, Assessment, and Demonstration Safety and Health Plan and as required by AFRL-HE-DIAG-OPS-001. The system diagnostic procedures determine the system operating parameters and serve as an advisory for the ADS Crew.

- ADS Crew did not measure power density throughout the range using methodology outlined in AFRL-HE-DIAG-OPS-001 and unit ADS Training, Assessment, and Demonstration Safety and Health Plan, which requires measurements be taken at 100 meter increments and recorded in the log book prior to event. Information is used to calculate exposure parameters.

- Range finder on the ADS is not operable. There was a range finder in use by Blue Force commander but range data was not properly employed by ADS crew. The distance to target, percentage of power, duration of exposure and weather conditions are key factors in determining proper use of the ADS.

- ADS Crew did not video tape internal cabin activity so actual systems setting at the time of firing on Role Player (P3) are not available for calculation of exposure; neither was the log kept due to P1 having to single handily maintain and troubleshoot the system as well as advise P2 of target data.

- Unit's ADS Training, Assessment, and Demonstration Safety & Health Plan states that all ADS Operators will receive training from AFRL/HED. Mishap ADS Operator (P2) was being trained on-the-job without a formal or informal training plan.

- ADS Crew did not realize that the ADS, when it came back to "stand-by" mode had defaulted to the previous setting of 100% power and allowed at least a 4 second trigger pull.

- Based on the ADS settings, the trigger radiation time, and the estimated location Role Player (P3) was shot, it was determined they were within the Fresnel maximum. The Safety and Health plan clearly states that all demonstrations will be conducted beyond the Fresnel maximum.

- Role Player (P3) was overexposed to heat in excess of the 12 J/cm² limit for a moving target allowed by the DoD and the unit Safety and Health Plan. The ADS setting should have been 50% for 1 second IAW guidance in the USJFCOM Safety and Health Plan.

- Currently in the SFG Advance Technology Section only the Crew Commander (P1) and ADS Operator (P4) had been trained by the AFRL ADS ACTD management team at Kirtland. No formal training documentation exists, no diplomas, no course content chart, no in house lesson plan and no training record annotations.

- All ADS personnel were unaware that heat exposure is a product of range, distance and power.

- AFRL ADS ACTD Training material provided during the investigation does not demonstrate in clear terms...
the danger of and how to determine the Fresnel maximum.

- There was no reference material available at the EUF event that would have aided the ADS Crew in determining quickly the range/power/duration required/suggested for each scenario; no noticeable Operational Risk Management was taken prior to the event with reference to distance/range/power decision making.

5. Primary Findings:

**Finding 1:** ADS Crew Commander did not conduct the system diagnostic IAW the unit’s ADS Training, Assessment, and Demonstration Safety and Health Plan and AFRL-HE-DIAG-OPS-001.

**Finding 2:** ADS Crew did not measure power density throughout the range using methodology outlined in AFRL-HE-DIAG-OPS-001 and unit ADS Training, Assessment, and Demonstration Safety and Health Plan. Requirement is for measurements to be taken at 100 meter increments and recorded in the log book prior to event. Information is used to calculate exposure parameters.

**Finding 3:** (Causal) Built-in range finder on the ADS is inoperable. Blue Force commander had a hand-held range finder. ADS Crew did not employ/request range data or use the hand-held range finder for distance measurement. Distance is an important factor in ensuring ADS exposure is below maximum allowable Joules; IAW methodology outlined in AFRL-HE-DIAG-OPS-001 and unit ADS Training, Assessment, and Demonstration Safety and Health Plan.

**Finding 4:** ADS Crew did not video tape internal cabin activity and there was no log kept; crew commander single handedly maintained and troubleshot ADS and advised operator of target data.

**Finding 5:** (Causal) Mishap ADS Operator was locally trained but no formalized unit training program or documentation was developed. Mishap Operator was not trained by AFRL/HED as is stated in the unit ADS Training, Assessment, and Demonstration S&H plan.

**Finding 6:** (Causal) When ADS is powered down to pre-mission and subsequently brought back to "stand-by" mode, it defaults to the previous settings; ADS crew unaware of the ADS default to the previous setting of 100% and 4 seconds.

**Finding 7:** (Causal) Event #5 begins closer to the ADS than event #3 & 4. Based on the ADS settings, the trigger radiation time, and the estimated location of mishap person being 374 yards from the ADS, it was determined they were within the Fresnel maximum. The Safety and Health plan clearly states all demonstrations will be conducted beyond the Fresnel maximum.

**Finding 8:** Mishap person overexposed to heat in excess of the 12 J/cm² limit for a moving target allowed by the DoD and the unit Safety and Health Plan. The ADS setting should have been 50% for 1 second IAW guidance in the USJFCOM Safety and Health Plan.

6. Primary Recommendations:

**Recommendation 1:**

6.1. Related Findings: 5, 8

6.1.2. Hazard/Deficiency: Lack of comprehensive training

6.1.3. Recommendation 1: ADS training should emphasize the bio-effect dangers and possibilities of injury when system is not properly employed. Trainee should understand the factors that are used to calculate bio-effect exposures. Trainee should understand “danger zones” and be able to determine in different situations the best and safe exposure settings. Trainee should understand the ramification of improper employment of ADS.

6.1.4. AF Form 847: --

6.1.5. AFTO Form 22: --

6.1.6. OPR: AFRL / DEH
**Recommendation 2:**

6.2.1. Related Findings: 5
6.2.2. Hazard/Deficiency: Lack of comprehensive training
6.2.3. Recommendation 2: ADS Operators will attend an improved training course at AFRL ADS ACTD; training will be formally annotated and tracked IAW Unit Safety and Health Plan.
6.2.4. AF Form 847: --
6.2.5. AFTO Form 22: --
6.2.6. OPR: 820 SFG / CC
6.2.7. OCRs: AFRL / DEH;

**Recommendation 3:**

6.3.1. Related Findings: 5, 8
6.3.2. Hazard/Deficiency: Training
6.3.3. Recommendation 3: Unit should develop, with the help of AFRL ADS ACTD, a Train-the-Trainer course and develop a detailed localized and documented training program to develop a cadre of qualified operators and Crew Commanders. The Unit Safety and Health Plan should then be addressed to allow qualified trainers to train operators locally.
6.3.4. AF Form 847: --
6.3.5. AFTO Form 22: --
6.3.6. OPR: 820 SFG / CC
6.3.7. OCRs: AFRL / DEH;

**Recommendation 4:**

6.4.1. Related Findings: 5
6.4.2. Hazard/Deficiency: Training
6.4.3. Recommendation 4: All current ADS operators need to attend remedial training at Kirtland AFB (AFRL) under an improved training course with focus on ADS effects on human targets.
6.4.4. AF Form 847: --
6.4.5. AFTO Form 22: --
6.4.6. OPR: 820 SFG / CC
6.4.7. OCRs: AFRL / DEH;

**Recommendation 5:**

6.5.1. Related Findings: 1, 2, 3, 4, 7
6.5.2. Hazard/Deficiency: Inadequate operating procedures/checklist
6.5.3. Recommendation 5: Unit should develop an ADS Operating Instruction that ensures all ADS operations comply with the mandatory Safety and Health Plan requirements before exposing personnel in exercises, assessments, and demonstrations.
6.5.4. AF Form 847: --
6.5.5. AFTO Form 22: --
6.5.6. OPR: 820 SFG / CC

**Recommendation 6:**

6.6.1. Related Findings: 4, 6, 7
6.6.2. Hazard/Deficiency: Span of operational control
6.6.3. Recommendation 6: ADS should be manned by a minimum crew of 3: 1 Crew Commander, 1 Operator, 1 ADS Technician.
6.6.4. AF Form 847: --
6.6.5. AFTO Form 22: --
6.6.6. OPR: 820 SFG / CC
Recommendation 7:
6.7.1. Related Findings: 8
6.7.2. Hazard/Deficiency: Overexposure
6.7.3. Recommendation 7: ADS Crew Commander will ensure that no personnel are overexposed during assessments, exercises, and demos by complying with unit Safety and Health Plan requirements. The ADS Crew Commander, prior to a training exercise, demonstration, or assessment will conduct an ORM to addresses the system settings and parameters for that event. This ORM will be part of the event plan and submitted to the commander for approval.
6.7.4. AF Form 847: --
6.7.5. AFTO Form 22: --
6.7.6. OPR: 820 SFG / CC

Recommendation 8:
6.8.1. Related Findings: 3, 6, 8
6.8.2. Hazard/Deficiency: Span of operational control
6.8.3. Recommendation 8: ADS Crew Commander, when firing the ADS, must be able to supervise the crew, observe target, and communicate with SF echelon directing use.
6.8.4. AF Form 847: --
6.8.5. AFTO Form 22: --
6.8.6. OPR: 820 SFG / CC

Recommendation 9:
6.9.1. Related Findings: 1, 2, 3, 4, 1, 8
6.9.2. Hazard/Deficiency: Span of operational control
6.9.3. Recommendation 9: During use, the ADS Crew Commander should order power, duration, and target to select based on situational analysis. For exercises that would be: input from SF echelon, confirmed by measurement the range to target, daily diagnostics planning data, weather effect, and exposure limitation. For an AOR that would be: input from SF echelon, range to target, weather effects, target threat, and political outcome.
6.9.4. AF Form 847: --
6.9.5. AFTO Form 22: --
6.9.6. OPR: 820 SFG / CC

Recommendation 10:
6.10.1. Related Findings: 2, 3, 7, 8
6.10.2. Hazard/Deficiency: Unknown equipment parameters
6.10.3. Recommendation 10: Operational system parameters should be developed and possessed by ADS Crew Commanders/Operators to enable decisions with respect to range, power, and duration
6.10.4. AF Form 847: --
6.10.5. AFTO Form 22: --
6.10.6. OPR: AFRL / DEH

Recommendation 11:
6.11.1. Related Findings: 1, 2
6.11.2. Hazard/Deficiency: Equipment and operational preparation
6.11.3. Recommendation 11: ADS will not be used in an assessment, exercise, or demo without a daily diagnostic to determine system operating parameters for making system setting decisions
6.11.4. AF Form 847: --
6.11.5. AFTO Form 22: --
6.11.6. OPR: 820 SFG / CC
Recommendation 12:
6.12.1. Related Findings: 1, 2, 3, 4, 5, 6, 7
6.12.2. Hazard/Deficiency: Span of Control
6.12.3. Recommendation 12: Unit should ensure that for every exercise, assessment, or demonstration that a system knowledgeable OIC or NCOIC provides leadership oversight.
6.12.4. AF Form 847: --
6.12.5. AFTO Form 22: --
6.12.6. OPR: 820 SFG / CC

Recommendation 13:
6.13.1. Related Findings: 6
6.13.2. Hazard/Deficiency: Equipment Function
6.13.3. Recommendation 13: ADS Software be developed to set the system to 0% Power/0% seconds when it boots up into arm from pre-mission mode.
6.13.4. AF Form 847: --
6.13.5. AFTO Form 22: --
6.13.6. OPR: AFRL / DEH

Recommendation 14:
6.14.1. Related Findings: 4, 8
6.14.3. Recommendation 14: ADS should be capable of recording system settings, video, and range to target. This is crucial in preventing possible future mishaps or international incidents.
6.14.4. AF Form 847: --
6.14.5. AFTO Form 22: --
6.14.6. OPR: AFRL / DEH

7. Other Findings and Recommendations of Significance: There have been no OFS entered for this mishap

8. Mishap Cost:
8.1. Environmental Cost: $0.00
8.2. Non-DoD Damaged/Destroyed Property: $0.00
8.3. DoD Damaged/Destroyed Property: $0.00
8.4. Total Mishap Cost: $0.00
8.5. DoDI Injury Cost: $17,748.00
8.6. Total Mishap Cost with Injuries: $17,748.00

9. Personnel Information:
Person Number: 1
9.1.1. Gender: Male
9.1.2. Age: 44
9.1.3. Grade: E6
9.1.4. Employment Status:
9.1.4.1. Tier 1: US Military and Coast Guard
9.1.4.2. Tier 2: USAF Regular
9.1.5. Duty Status:
9.1.5.1. Tier 1: On
9.1.5.2. Tier 2: No Further Status
9.1.6. AFSC/Job Series: 3P071
9.1.7. Assigned MAJCOM: Air Combat Command
9.1.9. Assigned Wing: 23 Wing
9.1.10. Assigned Group: 820 Security Forces Group
9.1.11. Assigned Base: Moody AFB GA
9.1.12. Role in Mishap: Commander
9.1.14. Injuries: There are no injuries entered for this person
9.1.15. Person Associated with Object(s):
9.1.15.1.1 Object Number: 1
9.1.15.1.2 Object Type: Directed Energy Weapon
9.1.15.1.3 Assignment Type: Operator / Handler / Maintainer

Person Number: 2
9.2.1. Gender: Male
9.2.2. Age: 24
9.2.3. Grade: E4
9.2.4. Employment Status:
9.2.4.1. Tier 1: US Military and Coast Guard
9.2.4.2. Tier 2: USAF Regular
9.2.5. Duty Status:
9.2.5.1. Tier 1: On
9.2.5.2. Tier 2: No Further Status
9.2.6. AFSC/Job Series: 3P051
9.2.7. Assigned MAJCOM: Air Combat Command
9.2.9. Assigned Wing: 23 Wing
9.2.10. Assigned Group: 820 Security Forces Group
9.2.11. Assigned Base: Moody AFB GA
9.2.12. Role in Mishap: Other, Describe: ADS Operator
9.2.13. Functional Area: Security Forces
9.2.14. Injuries: There are no injuries entered for this person
9.2.15. Person Associated with Object(s):
9.2.15.1.1 Object Number: 1
9.2.15.1.2 Object Type: Directed Energy Weapon
9.2.15.1.3 Assignment Type: Operator / Handler / Maintainer

Person Number: 3
9.3.1. Gender: Male
9.3.2. Age: 48
9.3.3. Grade: O4
9.3.4. Employment Status:
9.3.4.1. Tier 1: US Military and Coast Guard
9.3.4.2. Tier 2: USAF Regular
9.3.5. Duty Status:
9.3.5.1. Tier 1: On
9.3.6. AFSC/Job Series: C31P3
9.3.7. Assigned MAJCOM: Air Combat Command
9.3.9. Assigned Wing: 23 Wing
9.3.10. Assigned Group: 820 Security Forces Group
9.3.11. Assigned Squadron: 823 Security Forces Squadron
9.3.12. Assigned Base: Moody AFB GA
9.3.13. Role in Mishap: Other, Describe : Exercise Role Player
9.3.15. Injury Severity: Lost Time Case
9.3.16. Injuries:
   **Injury: 1**
   9.3.16.1.1 Injured Body Part:
   9.3.16.1.1.1. Tier 1: Extremities
   9.3.16.1.1.2. Tier 2: Lower
   9.3.16.1.2. Injury Type: Burns
   9.3.16.1.3. Injury Mechanism:
   9.3.16.1.3.1. Tier 1: Heat (Not Associated With Running Or Aerobics)
   9.3.16.1.3.2. Tier 2: Other
9.3.17. Person Associated with Object(s):
   9.3.17.1.1 Object Number: 1
   9.3.17.1.2 Object Type: Directed Energy Weapon
9.3.17.1.3 Assignment Type: Struck / Injured Directly / Indirectly By

10. Objects Information:
    **Object Number: 1**
    10.1.1. Object Type
    10.1.1.1. Tier 1: Directed Energy Weapon
    10.1.1.2. Tier 2: --
    10.1.2. Unique Object Identifiers:
    10.1.2.1. National Stock Number: --
    10.1.2.2. Part Number: --
    10.1.2.3. Serial Number: --
    10.1.2.4. Other: System 1

11. Safety Investigation Board Personnel:
    **Position: Board President**
    11.1.2. Grade: O5
    11.1.3 Phone(s):
    **Position: Investigating Officer**
    11.2.2. Grade: Pay Band 2
    11.2.3 Phone(s):
12. Releasing Official:
12.1. Organization: 23 Wing
12.3. Grade: E7
12.5. Phone(s):