



# Joint Targeting Cycle and Collateral Damage Estimation Methodology (CDM)



General Counsel  
10 Nov 2009

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# *Agenda*

- Background
- References
- Targeting and Collateral Damage
  - Definitions
  - Targeting Overview
  - Targeting Cycle key elements
  - Collateral Damage Estimation
- Summary
- Questions/Discussion



## *References*

- DOD Directive 2311.01, 9 May 2006, “DoD Law of War Program”
- CJCSI 5810.01, “Implementation of the DOD Law of War Program”
- CJCSI 3160.01, “No-Strike and Collateral Damage Estimation Methodology ”
- CJCSI 3122.06, “Sensitive Target Approval and Review (STAR) Process”
- Joint Publication 3-60, 13 April 2007, “Joint Targeting”
- DIA Instruction 3000.002, 15 July 2008, “U.S./Allied Targeting Analysis”
- JTCG-ME Publication, 61 JTCG/ME-05-4, 29 September 2008”, “Collateral Damage Estimation (CDE) Table Development”
- JTCG-ME Accredited CDE Tables, 9 January 2009



# *Joint Targeting Definitions and Processes*



# *Targeting and Fires Definitions*

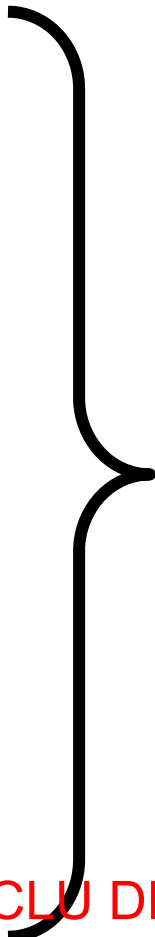
- Targeting: the process of selecting and prioritizing targets and matching the appropriate response to them, considering operational requirements and capabilities
  - The purpose of targeting is to integrate and synchronize fires into joint operations
  - Targeting supports the process of linking desired effects of fires to actions and tasks at the joint force component level
- Fires: the use of weapon systems to create a specific lethal or nonlethal effect on a target (JP 1-02)



# Target Definition

**Target: An entity or object considered for possible engagement or other action**

- Area
- Complex
- Installation
- Force
- Equipment
- Capability
- Function
- System
- Entity
- Individual
- Behavior



**Identified for possible action to support the commander's objective, guidance, and intent**



# Joint Targeting Cycle (JTC)



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Designed to provide a means to support achievement of JFC's objectives ... JP 3-60



# End State and Commander's Objectives



- Guidance:
  - Ground Rules/Policies
  - Establishes Scope/Restrictions
  - Drives subsequent phases of the targeting cycle
- Comes From:
  - Pres/SECDEF, CoCom, JFC
  - Law of Armed Conflict
  - Rules of Engagement

**Provides the critical link to Military Necessity**

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# Target Development and Prioritization

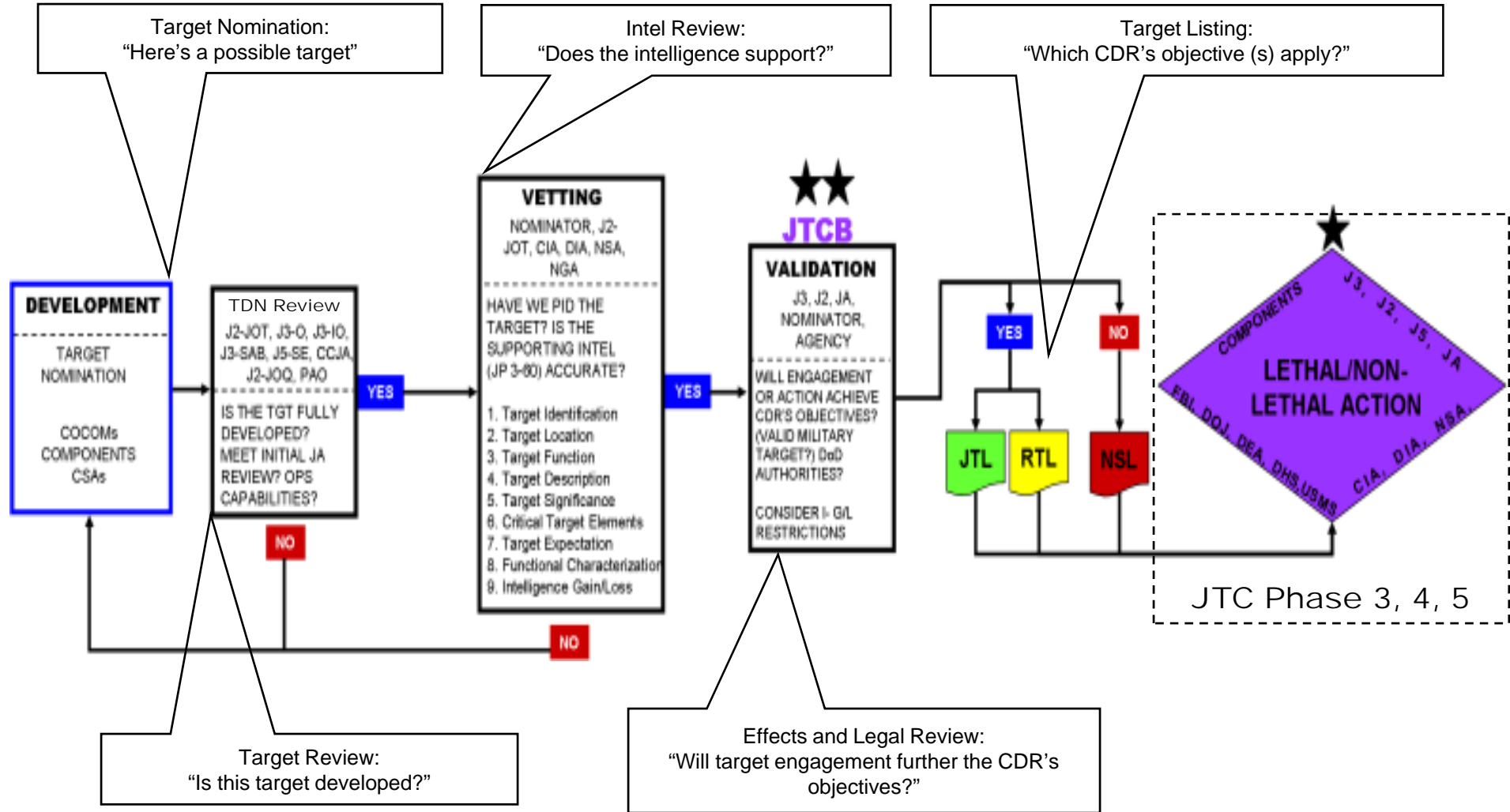


What targets must we engage to achieve our goal ?

- Target Vetting
  - Collective effort of the Intelligence Community
  - Examines
    - Target Identification, location, function, description, significance, critical elements, target expectation, functional characterization/collateral objects of concern, intel gain/loss
  - IC votes and provides advice on each target
  
- Target Validation
  - Compliance with commander's objectives
  - Law Of War (LOW)/Law Of Armed Conflict (LOAC) and Rules of Engagement (ROE)
    - Target's relevancy within the target system



# Joint Targeting Coordination Board (JTCB)





# Capabilities Analysis



- Evaluate available capabilities vs. desired effects to determine options
  - Effectiveness & efficiency of forces
  - Estimate the effects of attacks (kinetic & non-kinetic)
  - Weighs available forces w/ COAs
  - Inline with JFC's Objectives
- Weaponing:
  - Weapon/system to achieve effect
  - Efficient & effective use of resources
  - Objectives and desired effects
- Collateral Damage Estimation:
  - Unintended or incidental damage to persons or objects not the intended target and are not lawful targets



# Cdr's Decision and Force Assignment

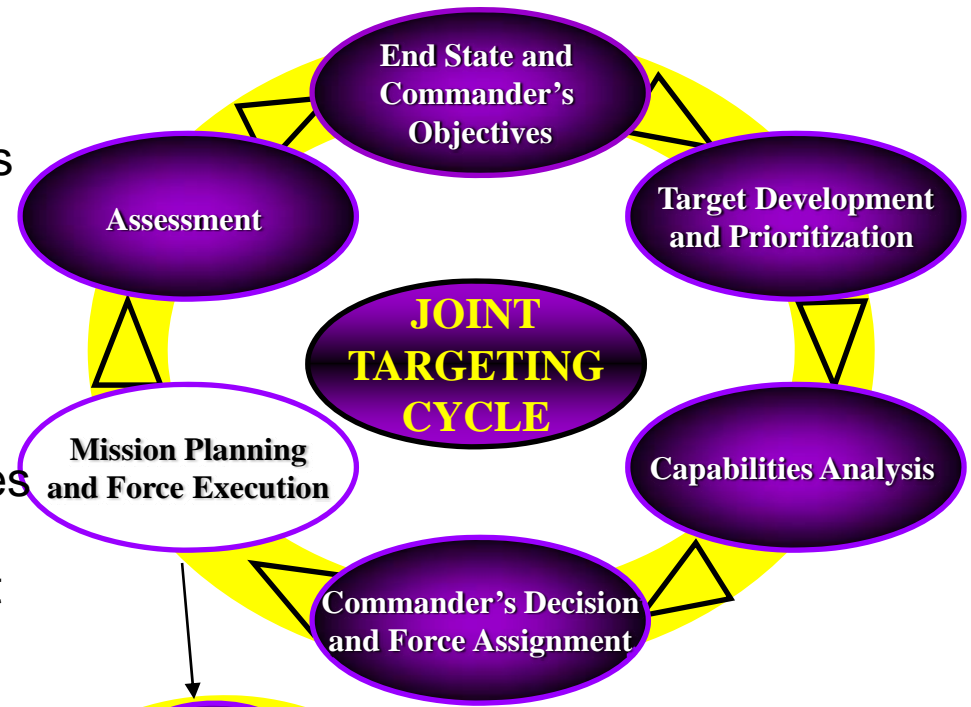


- Critical step in transitioning plans to execution
- Review previous steps for execution
- Validate target list changes
- Consolidate target development and capabilities analysis results
- Collateral damage decisions and Strike Approvals
  - Verify authorities—seek higher approval
- Assign responsibilities for engagement

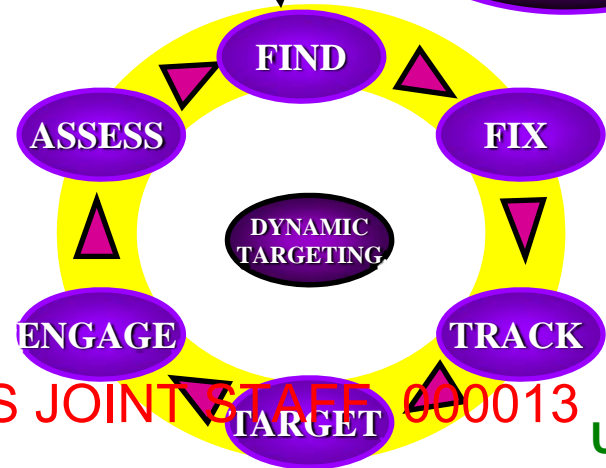


# Mission Planning and Force Execution

- Detailed planning conducted by tactical level forces
  - Based on commander's guidance/orders
  - Facilitated by open access to planners at the operational & strategic level
- Execution is continually monitored for
  - How the adversary responds/changes
  - Achievement of effects & Cdr's objectives
  - Performance of forces
  - Changes in the operational environment



Component targeting and engagements





# Combat Assessment



- Measures progress toward achieving the commander's objectives
  - MOP / MOE
- Provides:
  - Status
  - Benchmark for validating actions
  - Munitions effects assessment
  - Collateral Damage Assessment
- Generally the level at which a specified operation, task, or action is planned and executed should be the level at which such activity is assessed.



# *Collateral Damage Estimation (CDE)*

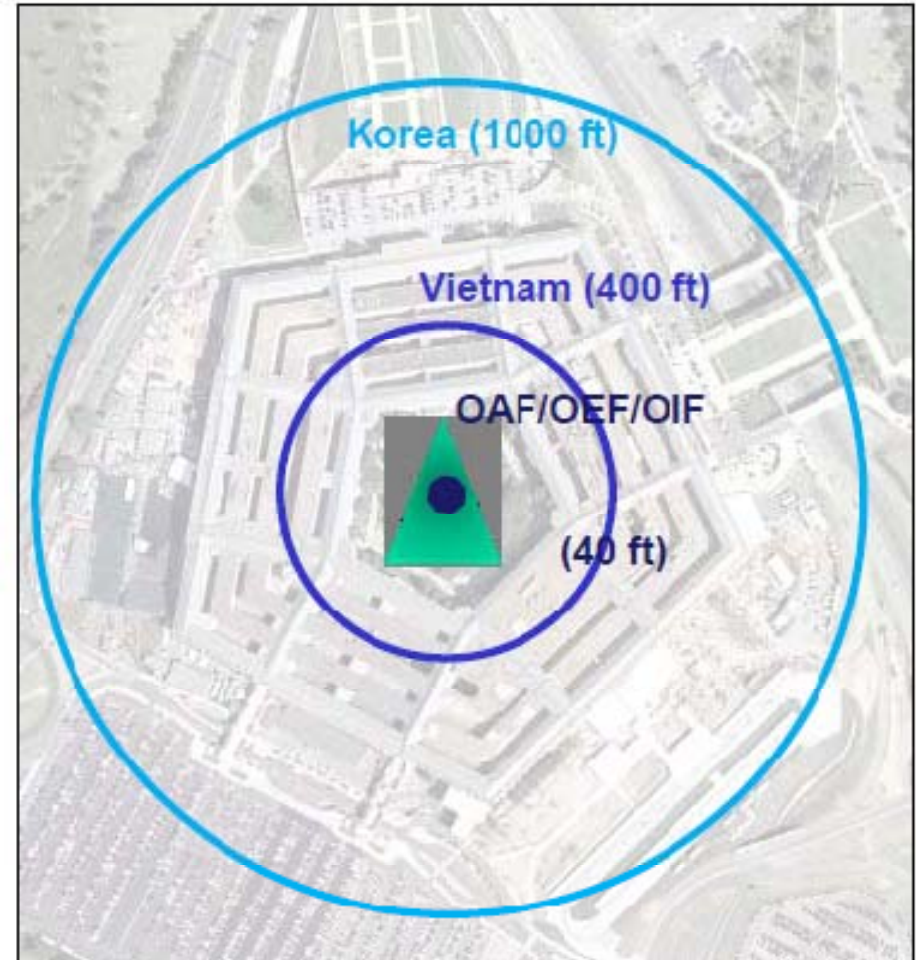
- Commanders must conduct a proper proportionality analysis to use the amount of force required to achieve a direct and concrete military advantage
- CDE Methodology provides the process to predict and mitigate collateral damage from conventional, non-nuclear kinetic strikes
  - Facilitates risk estimation and mitigation
  - Identifies target engagement's sensitivity and associated risks
  - Required on every target in accordance with Rules of Engagement
  - Target is weaponeered to balance accomplishing the mission with the risks to U.S. forces and the risk for collateral damage



# CDE Methodology - Technical Facts

All Munitions Technical Data is based on:

- The Joint Munitions Effectiveness Manual (JMEM) Weapon System (JWS)
- Data approved by the Joint Technical Coordinating Group/Munitions Effectiveness (JTTCG/ME)
  - Data updated every 6 months
- The CDE Methodology does not account for:
  - Weapon Malfunction
  - Operational Delivery Errors
  - Altered tactics
  - Unknown Transient Non-Combatant Personnel and/or Property



MK 84 class bomb, Med Alt





# *The 5 Basic Questions of CDE*

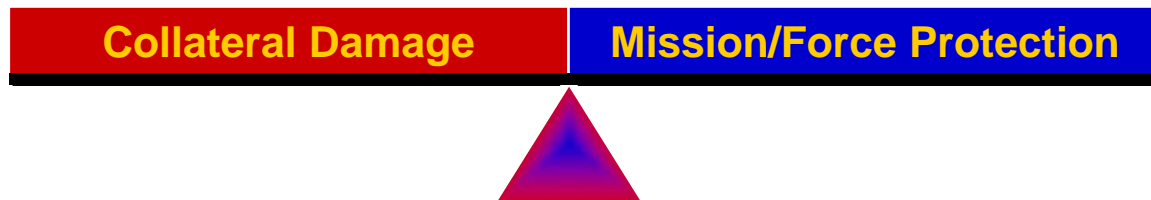
CDE methodology is five questions to be answered before engaging a target:

1. Can I PID the object I want to affect?
2. Are there protected or collateral objects, civilian or noncombatant personnel, involuntary human shields, or significant environmental concerns within the effects range of the weapon I would like to use to attack the target?
3. Can I mitigate damage to those collateral concerns by attacking the target with a different weapon or with a different method of engagement, yet still accomplish the mission?
4. If not, how many civilians and noncombatants do I think will be injured or killed by the attack?
5. Are the collateral effects of my attack excessive in relation to the expected military advantage gained and do I need to elevate this decision to the next level of command to attack the target based on the ROE in effect?



# *Risk Management*

- Commanders are responsible to evaluate and balance mission requirements and threat to friendly forces while taking all *reasonable* steps to mitigate the potential for Collateral Damage.
- The CDE Methodology codifies and standardizes the collateral damage estimate process supporting the Commander's *Evaluation of Risk* in the Military Decision Making Process (MDMP).





# CDM Process Guide



CDE Level 1		
Positive ID	Yes	No
Defined Facility Boundary	Yes	No
Authorized by ROE	Yes	No
Dual-Use Facility	No	Yes
Collateral Objects in CHA	No	Yes
CBR Plume Hazard	No	Yes
Environmental Hazard	No	Yes
CDE Level 1 Assessment	Low	High



CDE Level 4		
Assess and record collateral concern structure type(s)		
Select and enter CDE Level 4 Weaponneering Solution		
Is CDE Level 4 CER for the weaponneering solution less than the distance calculated in CDE	Yes	No
CDE Level 4 assessment	Low	High
Delivery heading restrictions		
Other mitigation techniques		

CDE Level 2		
Minimum Target Size Feasibility (CDE 2B/2C) ASUGM or SSBM	Yes	No
Yes - Proceed to CDE Level 3 No - Consider PGM Only		
PGM General Assessment (CDE 2A Unitary or Cluster) Collateral Objects in CHA?	No	Yes
CDE Level 2 Assessment	Low	High

CDE Level 3		
Measure and record distance from aimpoint(s), ASUGM EZ or SSBM sheaf to nearest Collateral concern(s)		
Is an Unmitigated Weaponneering Solution required to achieve desired effect?	No	Yes High
Is there a Mitigated Weaponneering Solution using CDE Level 3 CER Tables to achieve desired effect with a CER less than the distance in Level 2?	Yes	No
CDE Level 3 Assessment	Low	High
Weapon/Fuse Restrictions		

DTRA and/or NCM I Analysis

CDE Level 5		
Record each unshielded collateral concern on the CDE Level 5 Casualty Estimate (CE) Worksheet (functionality, dimensions, total area)		
Determine the percent of area affected and affected sq ft of each unshielded collateral concern and record on the CDE Level 5 CE Worksheet.		
Record the Day, Night and Episodic estimated population density for each unshielded collateral concern using the AOR's population density reference table on the CE worksheet.		
Determine the appropriate casualty factor for each unshielded collateral concern and record on the CE worksheet.		
Compute the casualty estimate, adding any DTRA / NCM I casualty estimate or human shields (involuntary/status unknown).	Day:	
	Night:	
	Episodic:	
Is the total casualty estimation less than or equal to the NCV?	Yes	No
CDE Level 5 assessment	Low	High

Refer to ROE & STAR Process

Final CDE Assessment					
CDE Level	Low/High	Weapon Class (PGM/ASUGM/SSBM)	Weaponneering Restriction	Heading Restriction	Casualty Estimate
CDE_____				_____	D:___N:___E:___

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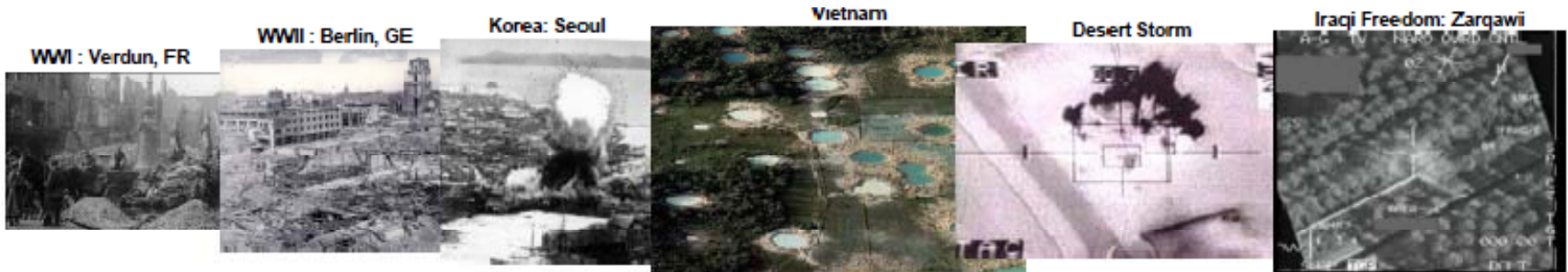
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# Summary of CDE in Joint Targeting



- Never before has a nation taken such measures and resources to reduce the likelihood of civilian casualties
  - Our processes and procedures are rigorous
  - The methodology is derived from physics based computer modeling backed up by weapons testing data and direct combat observations
  - Estimates are applied by commanders exercising informed judgment to mitigate civilian casualties while balancing their responsibility to accomplish the mission while defending themselves and their forces





# Questions/Discussion



# Back-Up (Vignette)



# *Target Value Analysis Definitions*

- High Value Target: A target the enemy commander requires for the successful completion of the mission. The loss of high-value targets would be expected to seriously degrade important enemy functions.
- High Payoff Target: A high value target whose loss to the enemy will significantly contribute to the success of the friendly course of action. High-payoff targets are those high-value targets that must be acquired and successfully attacked for the success of the friendly commander's mission.
- Time Sensitive Target: A joint force commander designated target requiring immediate response because it is a highly lucrative, fleeting target of opportunity or it poses (or will soon pose) a danger to friendly forces.



# Risk Management & CDE

- CDE 1: Target Validation / Initial Assessment
- CDE 2: General / Target Size Assessment
- CDE 3: Weaponering Assessment
- CDE 4: Refined Assessment
- CDE 5: Casualty Assessment



**MISSION RISK**

## CDE Level

Structural Damage	NO	NO	NO	NO	YES
Casualties	NO	NO	NO	NO	YES
Tactical Restrictions	NONE	Weapon	Weapon/Fuse	Weapon/Fuse/Delivery Heading	

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# Lawful Military Objectives

- Lawful Military Objectives
  - Contribute to the enemy's warfighting/war sustaining effort and its destruction would constitute a definite military advantage
  - Four elements that allow targets to be lawful military objectives:
    - Nature
    - Location
    - Purpose
    - Use

**Each target is assessed holistically on these elements**

**Critical Analytical Component in CDE Methodology**

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## *Positive Identification*

“It is an inherent responsibility of all commanders, observers, air battle managers, weapons directors, attack controllers, weapons systems operators, intelligence analysts, and targeting personnel to (CJCSI 3160.01):

- Establish Positive Identification (PID) and to accurately locate targets consistent with current military objectives and mission specific Rules of Engagement.
- PID is defined as the reasonable certainty that a functionally and geospatially defined object of attack is a legitimate military target in accordance with the Law of War and applicable Rules of Engagement.
- Identify potential collateral concerns prior to munitions release and target engagement (provide function and geospatial delimitations if able)
- Apply the Collateral Damage Methodology (CDM) with due diligence to mission objectives, force protection, and collateral damage.”



## *Dual-Use*

- Targets characterized as having both a military and civilian purpose/function are considered dual-use.
- In most cases, dual-use Targets consist of facilities/structures associated with providing support to the civilian population and the military effort (eg. senior governmental level command and control, media centers, public utilities)
- Commanders are responsible to determine the predominant functionality of LOW Protected Structures, based on current intelligence, and decide if the target is dual-use or not.
- ROE provides the authorizations and prohibitions regarding targeting Dual-Use Facilities.
- Regardless of the ROE in effect, civilian personnel working within the boundary of dual-use targets must be considered as noncombatant casualties for the purposes of casualty estimation



## *No-Strike Policy*

- Combatant Commanders identify, develop, maintain, and distribute to subordinate and supporting commands a list of No-Strike Objects for each Country within Area of Responsibility (AOR) and each OPLAN/OPORD Areas of Operation (AO)
- The National Intelligence Community will support and assist the COCOMs with No-Strike Object research, development, and production; validate additions to COCOM generated No-Strike Lists (NSL)
- A NSL is a list of all identified objects within a specified geographic area (Country or AO) functionally characterized as non-combatant / civilian in nature.

Updated and disseminated daily

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# *Categories of Collateral (No Strike) Objects*

- Category 1:

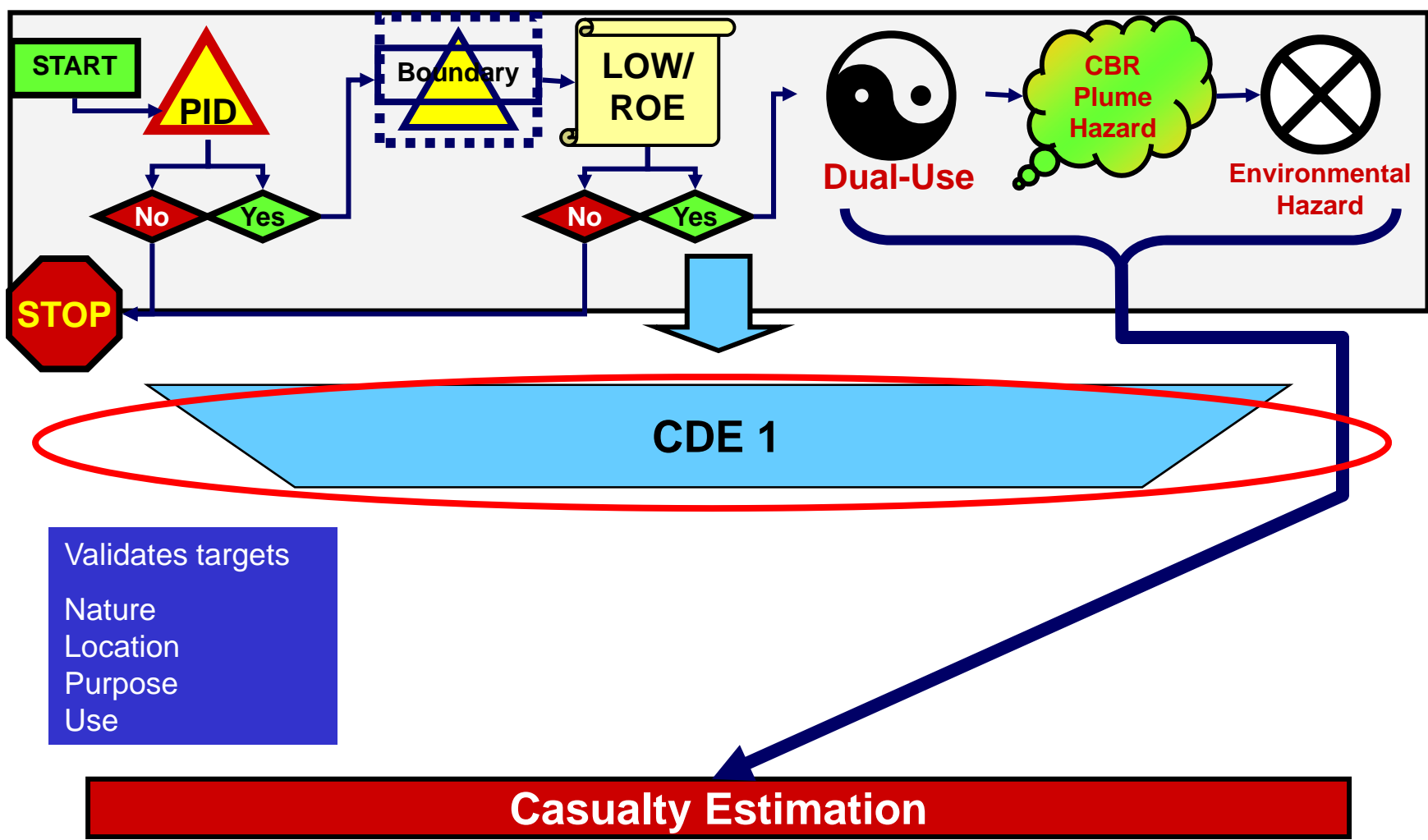
- Diplomatic Facilities
- Religious/Cultural/  
Historical
- Non-Governmental Orgs.
- Medical Facilities
- Public Education Facilities
- Civilian Refugee Camps
- Prisoner of War (POW) Camps
- Facilities with Environmental Concerns
- Dams and dikes

- Category 2:

- Non-Military Billeting (Housing, Hotels/Motels)
- Civilian Meeting Places (Arenas, Theaters, Parks, Stadiums, Markets, Convention Centers)
- Public Utilities (Power, Water, Electric, Gas, Fire & Police Stations, Banks, etc.)
- Agricultural Storage or Processing Facilities
- Facilities whose functionality is unknown



# Initial Collateral Damage Estimate (CDE)

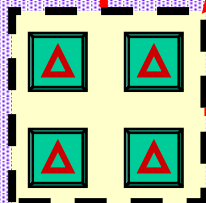
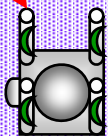
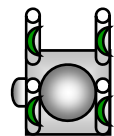




# CDE Level 1

If Collateral Concern is **Out** of the CHA,  
CDE = **Low**

Measured from Target Facility Boundary



CDE 1 CER\*

CDE 1 CER

**CDE 1**  
**Collateral Hazard Area (CHA)**

**Dominant Hazard = Fragmentation to Standing Personnel**

CDE Level 1		
Positive ID	Yes	No
Defined Facility Boundary	Yes	No
Authorized by RCE	Yes	No
Dual-Use Facility	No	Yes
Collateral Objects in CHA	No	Yes
CBR Plume Hazard	No	Yes
Environmental Hazard	No	Yes
CDE Level 1 Assessment	Low	High

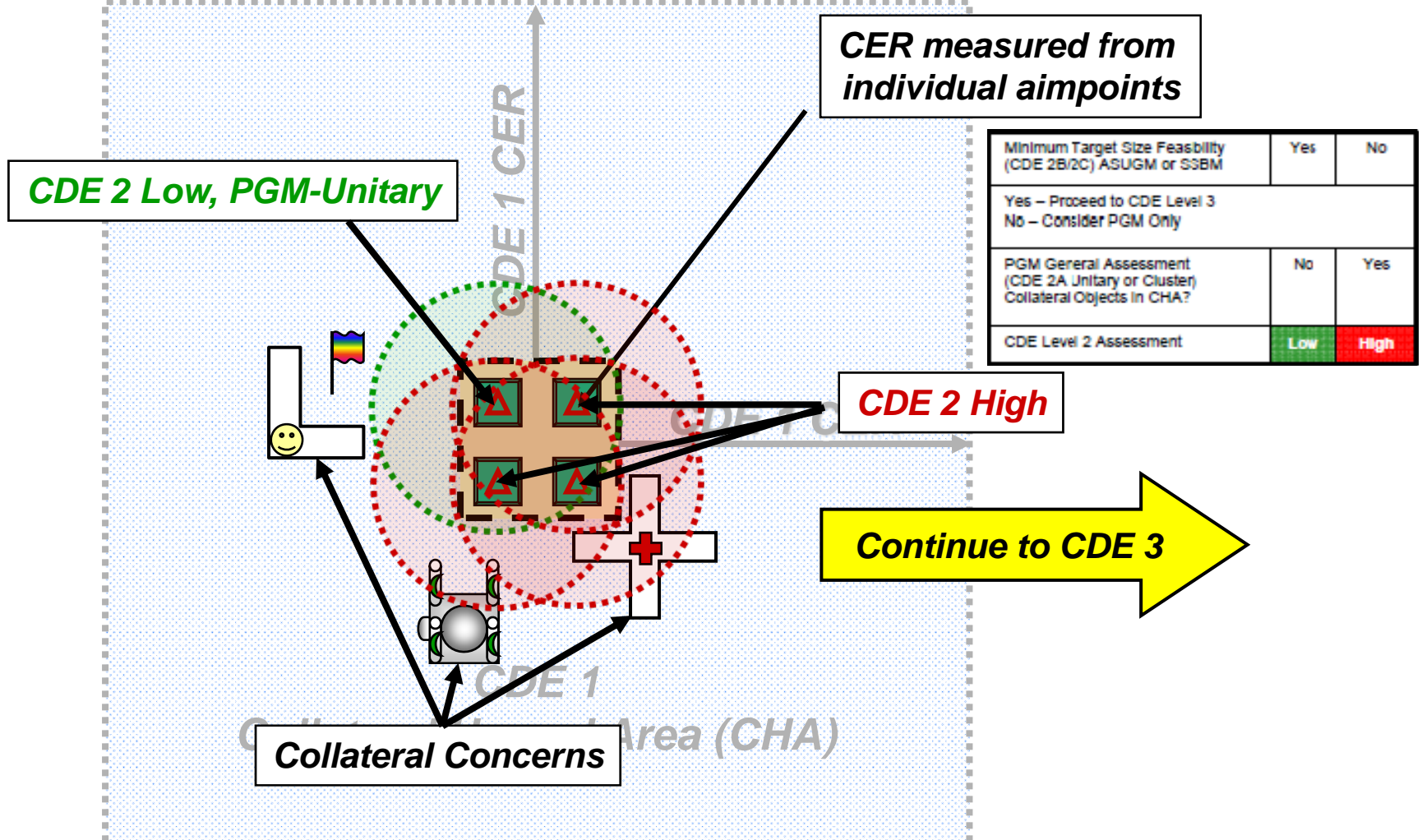
\*CER = Collateral Effects Radius

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# CDE Level 2



**Dominant Hazard = Fragmentation to Standing Personnel**

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# CDE Level 3

Continue to CDE 4

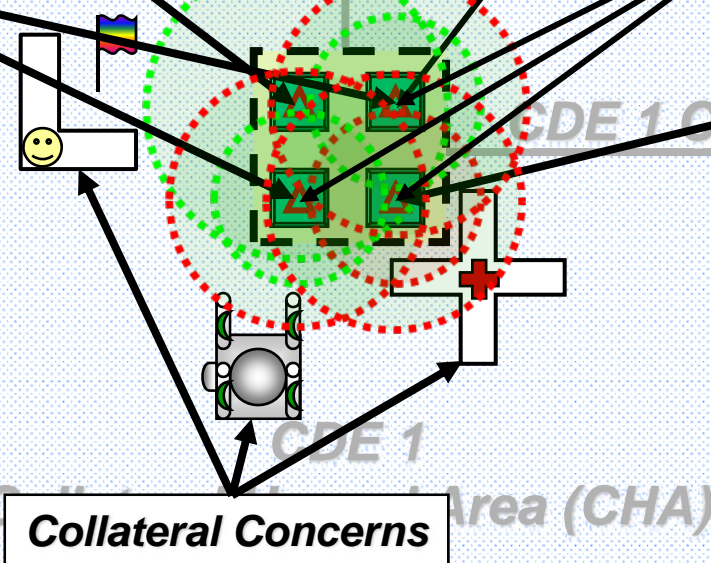
CER measured from individual aimpoints

CDE 2 Low

CDE 3 High (Un-Mitigated)

CDE 3 Low (Mitigated)

CDE 3 High (Mitigated)



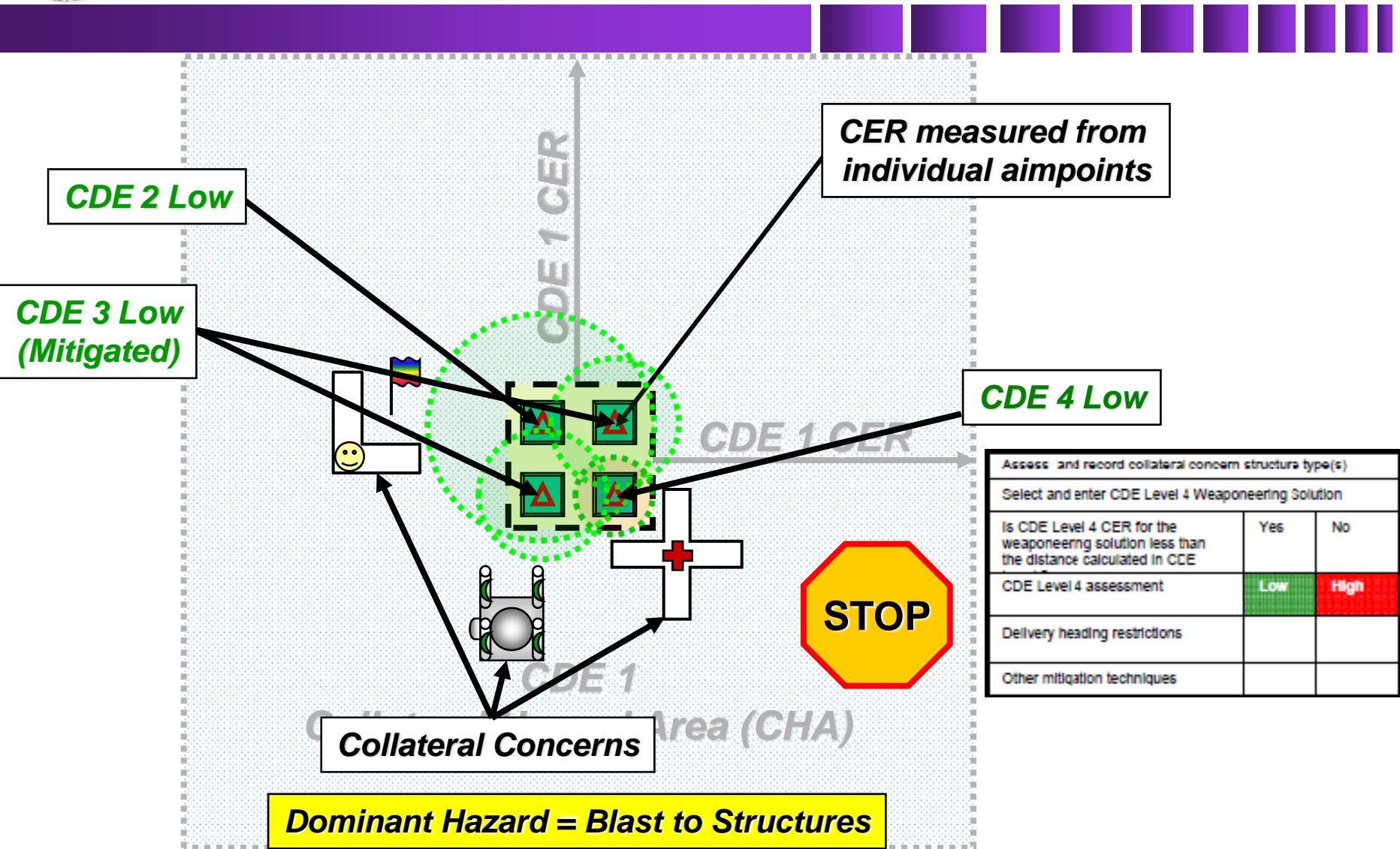
Collateral Concerns

Measure and record distance from aimpoint(s), ASUGM EZ or SSBM sheaf to nearest Collateral concern(s)		
Is an Unmitigated Weaponing Solution required to achieve desired effect?	No	Yes High
Is there a Mitigated Weaponing Solution using CDE Level 3 CER Tables to achieve desired effect with a CER less than the distance in Level 2?	Yes	No
CDE Level 3 Assessment	Low	High
Weapon/Fuse Restrictions		

**Dominant Hazard = Fragmentation to Standing Personnel (Unmitigated)  
Ejecta to Standing Personnel (Mitigated)**



# CDE Level 4



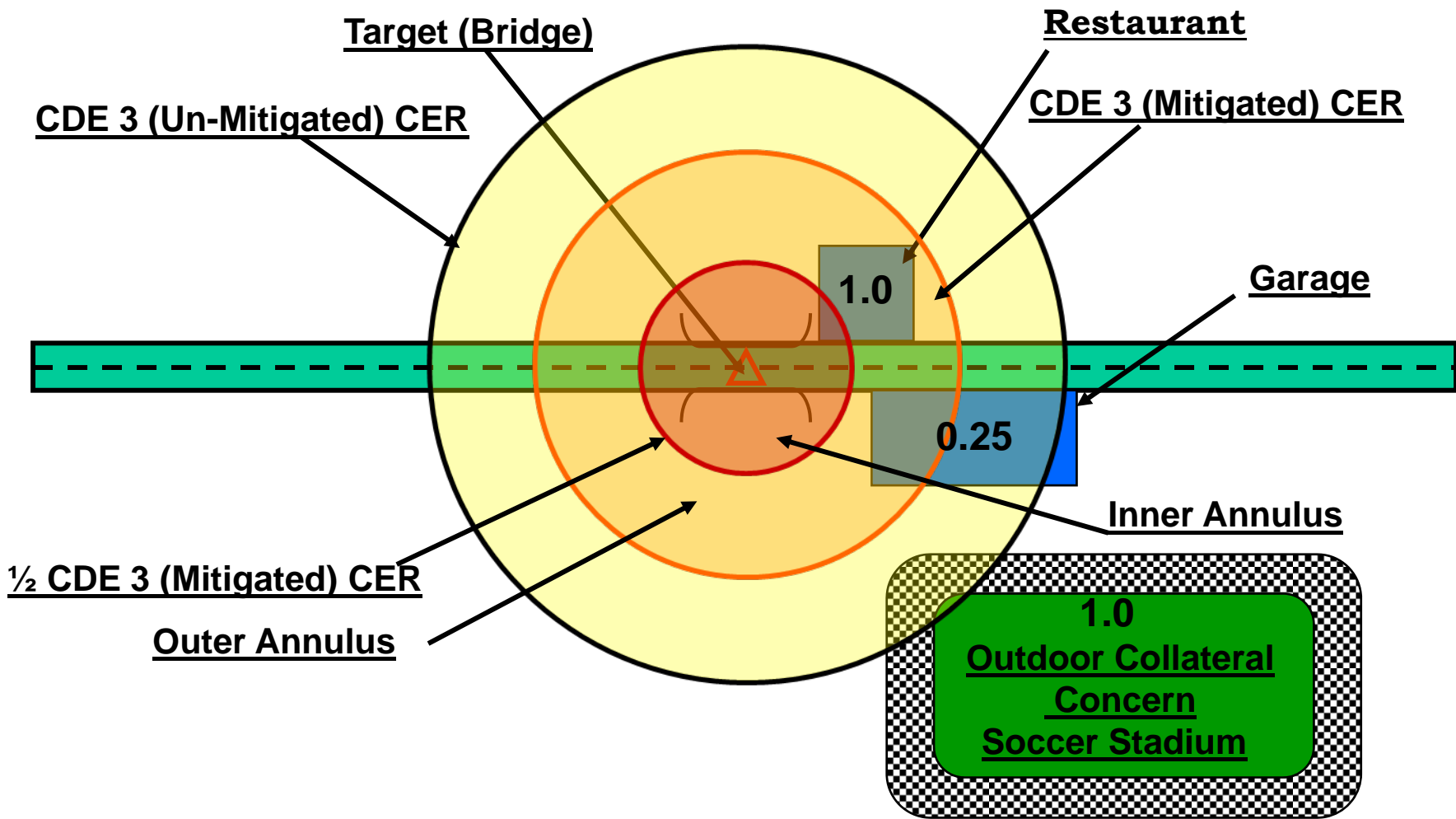


## *CDE Level 5*

- Casualty Estimation is not an exact science—pattern of life assists
- There are no precise means to predict non-combatant demographics
- Combatant Commanders are responsible to develop estimated non-combatant demographic factors
  - Factors for Day and Night are based on socialized cultural norms for the applicable AOR/Country
- Casualty Estimates are computed based on three key factors
  - Affected Area of collateral concerns
  - Estimated Population Density of the effected collateral concerns
  - Casualty Factor (Multiplier)



# CDE Level 5 (cont'd)





# Population Density Tables

Valid for: (AOR/Country)			
CDE Level 5 Population Density Reference Table			
Collateral Structure Functionality	Estimated Population Density		
	Day	Night	Episodic Events
<b>Residential Structures</b>			
Single Family Urban or Small Town, Upper and Middle Class			
Single Family Urban or Small Town, Lower Class and Slum			
Single Family Village or Rural Scattered, Lower Class			
Multi-Family Unit (Apartment, Condominium, Dormitory)			
<b>Institutions/Public Service</b>			
Religious			
Museum			
Library			
School			
College/University			
Hospital			
<b>Public Service Outlet</b>			
Store			
Restaurant			
Hotel/Motel			
<b>Office Building/Industrial Facility</b>			
Light Manufacturing			
Heavy Manufacturing			
Chemical, Refining, Cement			
Heat Processing (i.e. foundry)			
Craftworks			
<b>Transportation Facility</b>			
Station (Air, Rail, Bus, Subway, Gas)			
Transportation Repair (Garage, Hangar)			
Warehouse			
<b>Recreation/Entertainment</b>			
Indoor (Theater, Gymnasium)			
Outdoor Intensive (Stadium, Racetrack)			
Outdoor Extensive (Park, Zoo)			
<b>Auction</b>			
Indoor			
Outdoor/Intensive (Theater, Gymnasium, Casino)			
<b>Notes:</b>			
1. The table is based on population density per 1000 square feet.			
2. Combatant commands are responsible for tables for their assigned AOR. Combatant commands may use multiple tables to account for the disparity in population density throughout different regions of various countries.			
3. Day and night refer to socialized cultural norms for daytime/nighttime functional activities. Special consideration must be given to unique cultural practices and periodic events (i.e. religious holidays) that may influence the population density during daytime/nighttime hours as well as episodic events.			

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# *Sensitive Target Approval and Review Process* *(STAR)*

- The CDE Methodology (CDM) supports the identification of “*sensitive targets*”
- Sensitive Targets are those whose engagement present:
  - the potential for damage and/or injury to non-combatant property and persons,
  - potential political consequences,
  - or other significant effects estimated to exceed predetermined, situation-specific threshold criteria.
- Sensitive Targets are normally those assessed as CDE 5 High or those designated by the President or Secretary of Defense whose engagement present unacceptable strategic risk.
- Sensitive (STAR) Targets require approval by either President or Secretary of Defense.

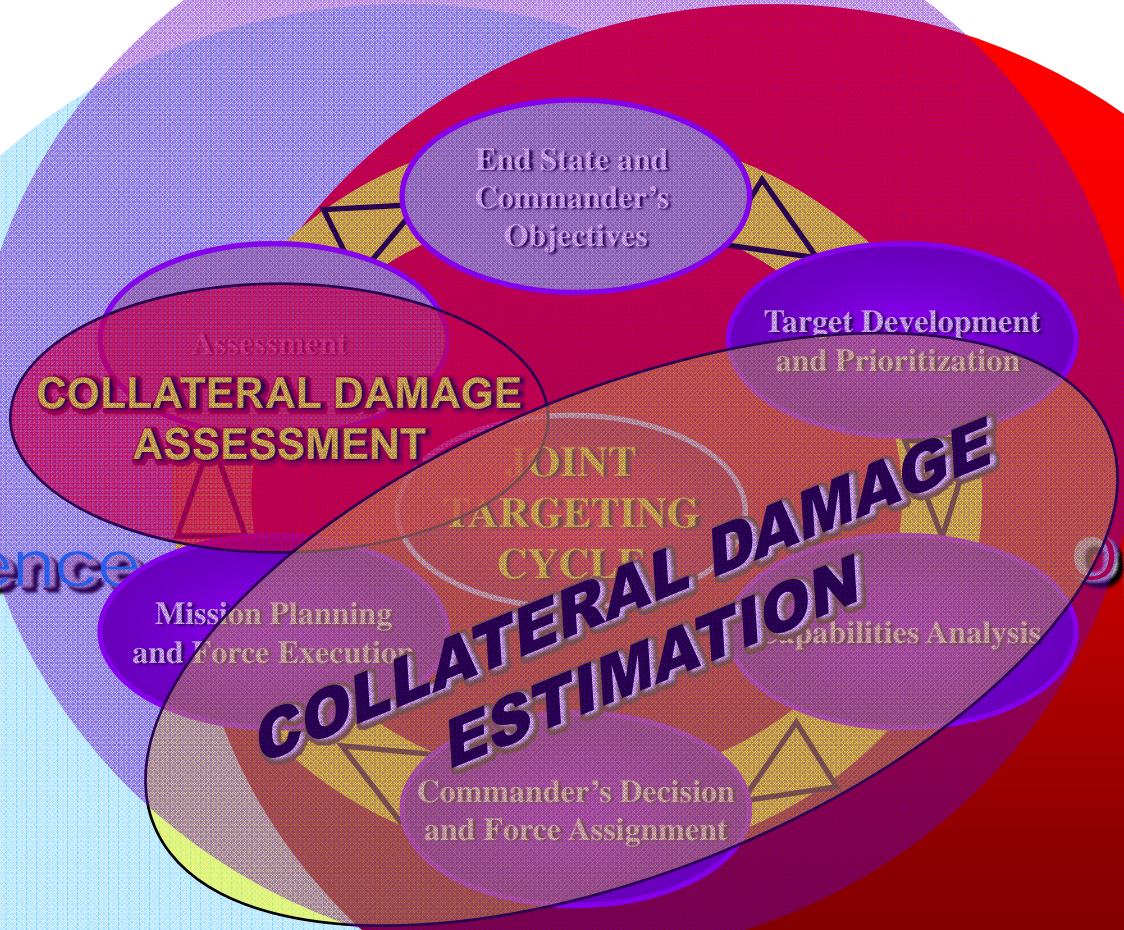


# CDE in the Joint Targeting Cycle

**Plans**

**Intelligence**

**Operations**



**Methods to prevent civilian casualties permeates the cycle**

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# Mitigating Weapon Effects

Effect	Delay Fuzing	Proximity Fuzing	Shielding	Delivery Heading	Aimpoint Offset
Frag.	√		√	√	√
Blast	√	√	√		√
Debris		√	√		√
Pen. & Cratering		√			
Thermal	√	√	√		
CBR		√	√		√
Delivery Error		√		√	





# Weapon Effects & Risks



CDE Level	Intended Use	Dominant Hazard	CER/CHA Criteria and Weapon Restrictions
1	Initial assessment for all conventional weapons	Fragmentation versus personnel	Less than 10% probability of serious or lethal injury to standing personnel
2A	General assessment for unitary and cluster PGMs		
2B	Minimum target size assessment for ASUGM based on delivery platform	Delivery error only	Less than 10% probability of serious or lethal injury to standing personnel No low or high assessment – feasibility only
2C	Minimum target size assessment for SSBM based on weapon system		
3A	Assessment for each PGM warhead in an unmitigated case	Fragmentation versus personnel (or blast if no weapon fragments/debris exist)	Less than 10% probability of serious or lethal injury to standing personnel Fuze for surface or air detonation
	Assessment for each PGM warhead in a mitigated case	Crater ejecta/debris versus personnel (or blast if no ejecta/debris exist)	Less than 10% probability of serious or lethal injury to standing personnel Fuze for complete detonation below grade
3B	Assessment for each ASUGM based on delivery platform and warhead in an unmitigated case	Fragmentation versus personnel (or blast if no weapon fragments/debris exist)	Less than 10% probability of serious or lethal injury to standing personnel Fuze for surface or air detonation Heading restriction for multi-warhead delivery
3C	Assessment for each SSBM weapon system/shell/fuze for Observer Adjusted method		Less than 10% probability of serious or lethal injury to standing personnel Fuze for surface or air detonation
	Assessment for each SSBM weapon system/shell/fuze for Predicted method		
4A	Kenned assessment for each PGM warhead based on collateral structure type in a mitigated case	Blast versus structures leading to blunt trauma injury to personnel	Less than 1 % structural damage to collateral structure Delay fuze for complete detonation below grade or complete detonation within target structure Excludes cluster munitions Requires delivery heading restrictions
4B	Refined assessment for each ASUGM warhead and associated delivery platform based on nearest collateral structure in a mitigated case		
4C	Refined assessment for each SSBM weapon system/shell/fuze based on nearest collateral structure using Observer Adjusted method		Less than 1 % structural damage to collateral structure Excludes ICM, RAP and enhanced range munitions
	Refined assessment for each SSBM weapon system/shell/fuze based on nearest collateral structure using Predicted method		

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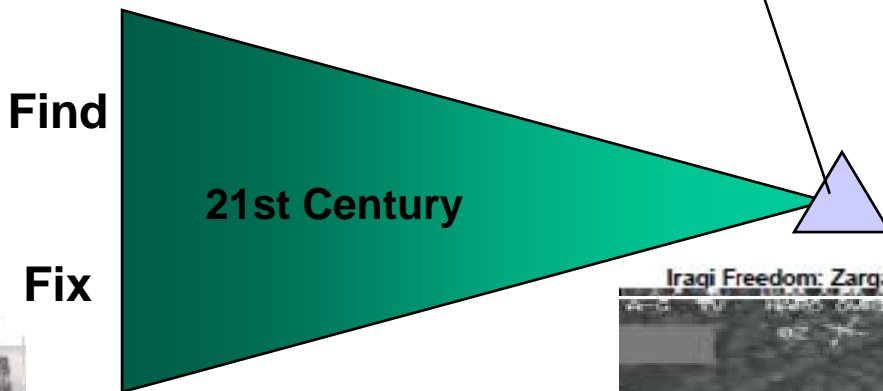
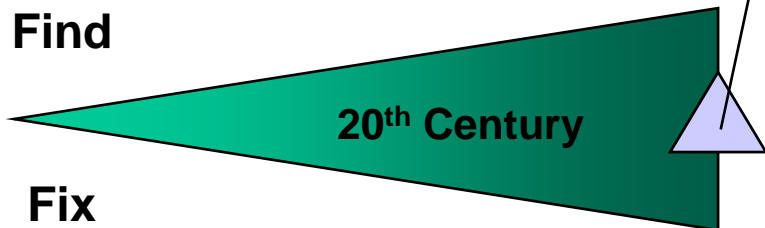
# *CDE Program of Instruction*

1. CDE Methodology Program of Instruction – Overview (1 hr )
2. CDE Methodology - Introduction (3 hrs)
3. Measuring and Mitigating Weapons' Effects (4 hrs)
4. CDE Level 1 – Target Validation / Initial Assessment (2 hrs)
5. CDE Level 2 – General / Target Size Assessment (2 hrs)
6. CDE Level 3 – Weaponeering Assessment (2 hrs)
7. CDE Level 4 – Refined Assessment (2 hrs)
8. CDE Level 5 – Casualty Estimation / Assessment (4 hrs)
9. CDE Automation – JADOCs CDE Wizard (4 hrs)
10. Practical Exercises (8 hrs)
11. CDE Methodology - Review (4 hrs)
12. Examination (4 hrs)



# Resource Allocation – Find/Fix versus Engage

Better intelligence and proportional precision engagement allows us to better discriminate valid military objectives from civilian population



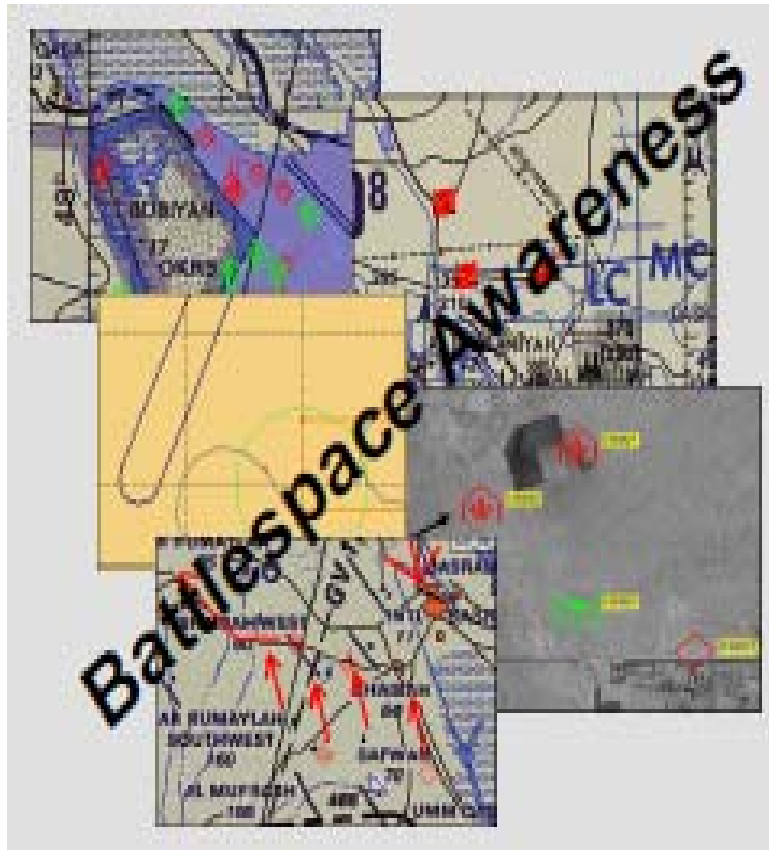
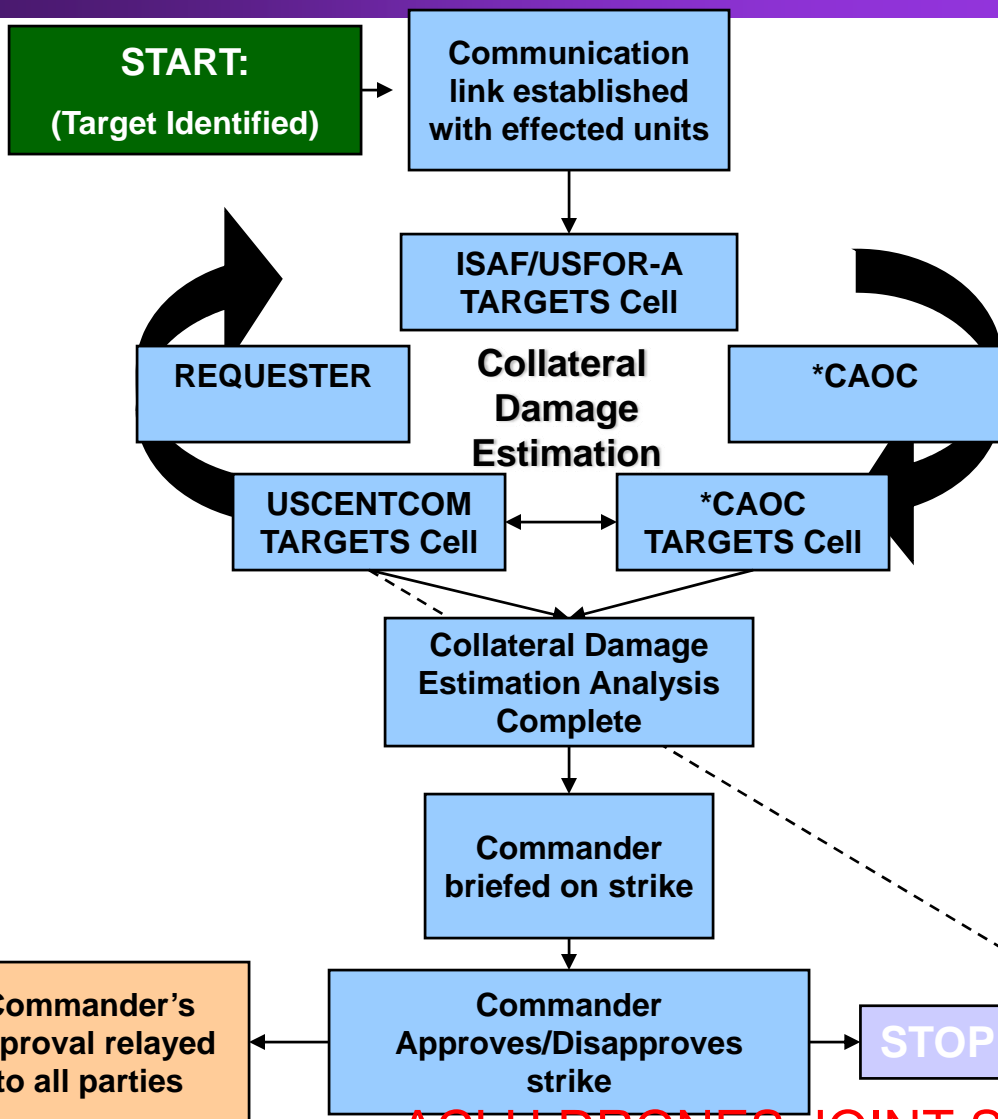


# *USCENTCOM Strike Approval Authorities*

- Rules of Engagement give the appropriate permissions to approve strikes based on Collateral Damage Estimation (CDE) call and target type
- Approvals, Rules of Engagement, and Collateral Damage Estimation (CDE) for strikes in Afghanistan are driven by nationality of the selected strike platform:
  - United States Rules of Engagement apply to all U.S. assets when used to strike targets
  - Other Rules of Engagement apply to all non-US assets when used to strike targets



# Collaborative CDE Process



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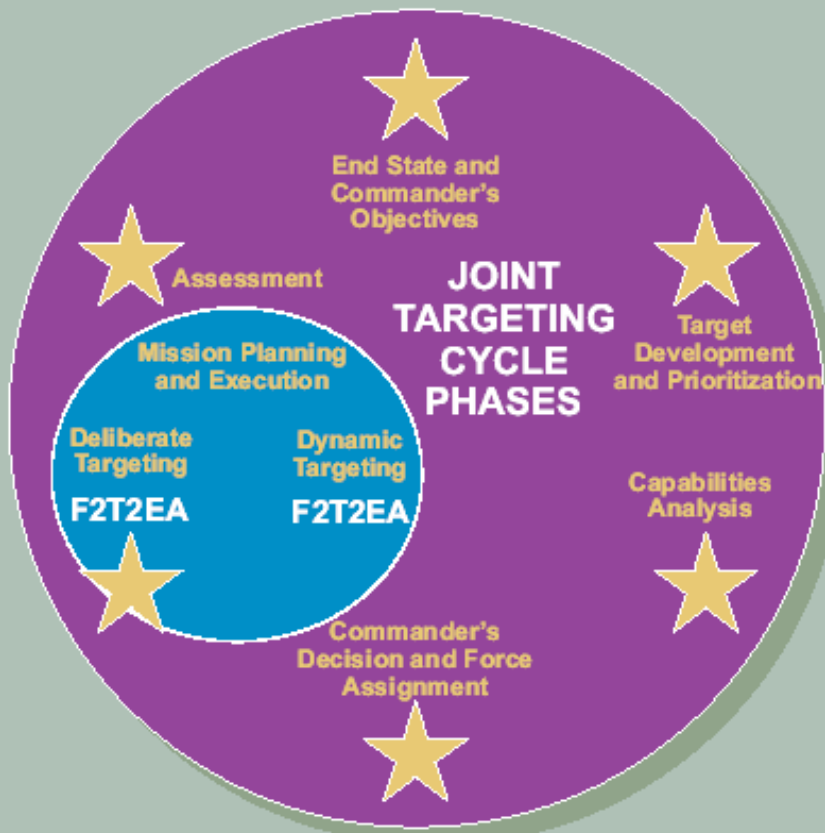
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# Mission Planning and Force Execution

## CORRELATION OF DELIBERATE AND DYNAMIC TARGETING DURING PHASE 5

- F2T2EA**
- Find
  - Fix
  - Track
  - Target
  - Engage
  - Assess





# Dynamic Targeting Cycle

