Annex C

(informative)

Integration readiness review (IRR)

C.1 General

Some department of defense (DoD) domains may require an IRR due to the nature and complexity of the system(s) being developed.

C.2 Annex C purpose

Annex C provides for the IRR of the corresponding content contained Clause 5, Clause 6, and Clause 7 of this standard for the reviews covered in those clauses.

C.3 Annex C tailoring

If a specific program requires an IRR, Annex C content changes status as defined in C.4.

C.4 Application of Annex C content

For programs that require an IRR, the content of C.5, C.6, and C.7 assume the status and are applied as listed in Table C.1.

Table C.1—Annex C content status and application

Annex C subclause	Contents status	Application
C.5	Becomes normative	Is a normative addition to Clause 5 of this standard.
C.6	Becomes normative when tailored	Is a normative addition to Clause 6 of this standard as tailored for the program.
C.7	Remains informative	Is added as application guidance to Clause 7 of this standard.

C.5 Requirements for an IRR

C.5.1 IRR purpose

The IRR shall be conducted to assess the readiness of a defined set of system hardware and software elements that are under configuration control to begin integrated hardware-software testing.

C.5.2 IRR description

The IRR shall confirm that

a) The specific hardware and software elements to be used in integrated testing represent a system configuration that has a reasonable expectation of being judged operationally effective and suitable.

b) Prior element-level testing produced adequate evidence that the specific hardware and software elements planned for integration testing are sufficiently mature to support successful integration.

c) The supplier's test planning, objectives, methods and procedures, scope and resources are adequate to begin subsystem integration testing in the laboratory.

d) Clear and complete traceability exists between the planned tests to the applicable program, engineering data, analysis, and certification requirements.

e) Known anomalies in the specific hardware and software elements to be used in integrated testing are assessed at sufficiently low risk to provide a reasonable expectation of integration test success.

f) The tool sets to use for integration testing in the system integration laboratory (SIL) or other equivalent system integration facilities have been verified to provide sufficient operational environment fidelity for integration testing, and are under configuration control.

C.5.3 IRR timing

The IRR shall be held prior to fully integrated system-level hardware-software testing (which is addressed in the test readiness review) after element-level tests have been successfully completed and groups of hardware and software elements are ready for subsystem or equivalent level integrated testing.

C.5.4 IRR entry criteria

The IRR shall be conducted only after the following events have been successfully completed:

a) The acceptability criteria for each of the IRR technical review products have been established for the specific program by tailoring the contents of Table C.2.

b) All preparatory actions in Table C.3 as tailored for the specific program have been successfully accomplished to support conducting the technical review.

c) All applicable test procedures have been validated for use in formal testing for the record, by dry runs or alternative methods.

d) All documentation in support of IRR has been completed to the degree to satisfactorily support IRR.

C.5.5 IRR content

C.5.5.1 Products to be reviewed at IRR

The following work products at a minimum shall be reviewed by the IRR team. Other products may be added as necessary during tailoring of Table C.2 for the specific program.

a) System technical documentation
b) Test environment
c) Program execution and process control
d) Risk assessment
e) Program cost and schedule estimates

C.5.5.2 Conduct of the IRR

IRR participants shall assess the IRR work products and judge the products' acceptability according to the applicable criteria in Table C.2 as tailored for the specific program.

C.5.5.3 IRR outputs

a) Key IRR outputs shall include the following:

   1) Verification that the system elements under test are sufficiently mature, defined and representative to accomplish the planned test objectives
   2) Completed and approved test plans and procedures for the planned formal test event
   3) Complete identification and allocation of all required test resources to the planned test
   4) Verification that all planned preliminary or informal tests have been conducted and that the results satisfactorily indicate that the formal test event can begin
   5) Lists of any known anomalies and hardware or software limitations as a result of prior element-level testing, and a determination that their risk to the planned testing is sufficiently low to proceed
   6) A documented contingency plan for addressing technical issues, obstacles, or problems that might occur during conduct of the test
   7) An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans
   8) IRR team verification that test planning, objectives, methods and procedures, scope and resources are adequate to begin subsystem integration testing in the laboratory
   9) An IRR team recommendation to commence formal integration testing

b) The IRR summary report shall be distributed containing the following attachments:

   1) List of attendees
   2) Final copies of all presentations
   3) Updated risk assessment and mitigation plans
   4) Documented action items including those required for closure
   5) The tailored IRR detailed criteria tables as completed following the technical review
   6) Recommendation on readiness to commence the formal test event
   7) Meeting minutes

C.5.6 IRR exit criteria

The IRR shall be deemed completed only after the following events have been successfully completed:

a) All action items submitted during the technical review have been appropriately resolved.
b) All actions listed in the action items required for closure have been completed and approved by the required parties.
c) The content of corrective action plans, if any, for issues identified in the IRR is sufficiently complete and unambiguous to enable successful completion of all corrective actions.
d) Each of the technical review products listed in Table C.2 as tailored for the specific program meets all of its acceptability criteria, or has a corrective action plan documenting the corrective actions required to achieve acceptability.
e) The acquirer and supplier concur that the risk level is acceptable.
f) All baselines in the applicable configuration management (CM) system(s) are current and consistent with the audited IRR work products.
g) The IRR chair formally closes the review.

C.6 IRR detailed criteria

C.6.1 IRR technical review products acceptance criteria

Table C.2 lists the products that should be reviewed at IRR, and the associated acceptability criteria that should form a sufficient basis by which to assess each product's content as acceptable to support a successful IRR. If a given program requires an IRR, specific products and associated acceptability criteria shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement, to support a given program.

Table C.2—IRR technical review products acceptability criteria

Product	IRR acceptability criteria
System technical documentation	a) The Test and Evaluation Master Plan (TEMP) is current, approved, and includes sufficient structure and objectives to support integration testing. b) The requirements to be verified by the formal integration test under review include all approved changes. c) The configuration of the hardware and software elements under test is clearly defined. d) The design of the hardware and software elements under test is current and includes all approved baseline changes. e) The hardware and software elements under test are under configuration control by the CM organization. f) The hardware and software elements under test are judged sufficiently mature to begin formal integration testing. g) Any applicable key performance parameters (KPP) or key system attributes (KSA) to be verified during the integration test under review have been traced into the applicable test cases. h) Any anomalies or deficiencies are documented and assessed at low risk. i) The approved test plan is robust enough to ensure the full verification of all requirements to be verified by the integration test under review. j) The test plan is consistent with the required verification methods and levels for the requirements planned for verification by the integration test under review. k) The test procedures are consistent with the required verification methods and levels. l) The test procedures for each test case, together with the planned test input data and drivers, are correct, complete, and sufficiently robust to verify all of the requirements allocated to the test case. m) The test procedures are sufficiently detailed to be repeatable. n) The test procedures are in compliance with the approved test plan. o) The system safety aspects of the test configuration and its environment have been evaluated, the safety approaches have been deemed adequate, and have been incorporated as required into the relevant integration test procedures. p) The cybersecurity and program protection plans are sufficient to support integration testing. q) Bi-directional traceability that is correct, complete, and consistent is provided between the requirements to be verified by the integration test under review and the test procedures and test cases in which the requirements will be verified.

Product	IRR acceptability criteria
Test environment	a) The SIL (or equivalent) and facility configuration is stable, under configuration control, and meets the integration testing requirements. b) The test environment, including all hardware, software, emulators, and simulators is sufficiently robust to adequately verify the requirements to be verified. c) The test environment has the required components to support verification of system security requirements. d) Sufficient validation has occurred prior to the planned formal test event to ensure that the test environment will correctly perform the functions necessary to support the integration test under review.
Program execution and process control	a) Personnel roles and responsibilities are documented, clear, and concise, both for the acquirer and the supplier including test witnessing requirements, and are agreed to by the acquirer and supplier. b) Processes to be followed during test execution are defined and documented and will result in a controlled and disciplined test execution. c) Appropriate security test facilities, test equipment, schedules, and personnel are adequate and available to support the planned integration test. d) The anomaly reporting system is functional. e) The failure reporting and corrective action system (FRACAS) is functional. f) The presence and role of QA personnel are sufficient to ensure that 1) The test process is followed. 2) Test execution rigorously follows the test procedures with any deviations documented as redlines. 3) All problems or deficiencies encountered during testing are appropriately documented. 4) The test log faithfully documents the execution of the test, including test start, test end, interruptions and anomalies.
Risk assessment	a) Technical risks are identified, and mitigation plans are in place. b) Risk management process is in place demonstrated by documented execution results of existing mitigation plans associated with the purpose of the review.
Program cost and schedule estimates	a) Test schedules have been finalized and are feasible. b) Updated cost estimate fits within the existing budget. c) Earned value management (EVM) status supports transition to integration testing in the laboratory.

C.6.2 IRR preparation

Table C.3 lists the actions that should be considered during preparation for the IRR. The responsible people listed are those most often tasked with the listed preparation actions, but the acquirer and supplier may agree to assign the actions to different people or organizations depending on a given program's organizational structure. If a given program requires an IRR, the specific actions shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement. If a given program requires an IRR, responsibilities shall be assigned to people or organizations in accordance with the acquirer-supplier agreement.

Table C.3—IRR technical review preparation actions

Responsible person	IRR preparation actions
Program manager	a) Approve, fund, and staff the IRR as planned in the Systems Engineering Plan (SEP) developed by the systems engineer. b) Appoint an IRR chair no later than 90 days prior to the technical review, in coordination with the systems engineer and program test lead. c) Coordinate a preliminary agenda between the program integrated product team (IPT) and other acquirer subject matter experts (SME) no later than 30 days prior to the IRR.
Systems engineer	a) Ensure adequate plans are in place to complete the technical activities for the integration testing phase and to proceed from integration testing to the test readiness review (TRR). b) Ensure all of the technical review products whose acceptability criteria are defined in Table C.2 are completed for the IRR.
Program test lead	a) Coordinate arrangements for IRR location and support. b) Coordinate requirements for the IRR chair with the systems engineer and program manager. c) Coordinate the preliminary IRR agenda with the systems engineer and program manager. d) Ensure the preparation of all presentation material is coordinated across IPTs.
IRR chair	a) Determine IRR team membership. b) Approve the final IRR agenda. c) Approve any final Clause C.6 IRR detailed criteria tailoring for the specific program. d) Identify any specific elements for in-depth technical review as required.

C.6.3 IRR conduct

Table C.4 lists the technical review elements and associated content details that should be considered for the conduct of the IRR. If a given program requires an IRR, the specific elements and their content details shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement, to support a given program.

Table C.4—IRR conduct elements

IRR review element	Content details
Introduction, agenda, administrative	a) Review location layout and safety procedures b) Security procedures if applicable c) Introduction of chair and team members d) Purpose of the technical review e) IRR agenda f) Action item procedures g) Risk assessment procedures h) Program overview i) Overall test and evaluation (T&E) program overview and how the planned integration test(s) support the overall program
System technical documentation	a) Requirements planned to be verified during the integration test under review b) Any changes to these requirements that have been approved since CDR c) Required verification methods and verification level(s) for each requirement planned to be verified during the integration test under review d) Any changes to the design of the hardware and software elements under test that have occurred since CDR that affect the integration test under review e) Any changes to the test plan(s) that cover the integration test under review that have occurred since CDR f) Test procedures and test cases for the integration test under review including setup, execution, data capture, and data analysis/reduction g) Description of test driver data and scenarios to be used with the test procedures h) Results of any dry runs, including anomalies encountered and any anticipated problems with requirements verification i) Bi-directional traceability among the test cases, test procedures, design documentation of the hardware and software elements under test, and the requirements documentation covering the requirements to be verified j) Hardware and software descriptions, and human procedures and user manuals required for the integration test under review k) Specific configuration of the hardware and software elements under test including version(s) or release(s) of software; configuration identification and status accounting documentation for the hardware and software elements under test l) All known problems or deficiencies at the start of the test for the hardware and software elements under test, along with their severity levels and expected impacts to testing m) Expected test results with success criteria and how the test results will affect the program n) Status of program metrics

IRR review element	Content details
Test environment	a) Description of the SIL (or equivalent) including hardware, software, automated test equipment, test tools, simulators, emulators, drivers, etc. b) Confirmation by the CM organization that the test environment is validated and under configuration control c) Status of validation performed on the test environment to ensure it correctly performs the functions necessary to support the planned integration test d) All known test environment problems or deficiencies and their expected impact on the testing e) Any test limitations or other conditions that might impact conduct of the integration test
Program execution and process control	a) Test program staffing—organization, acquirer-supplier interfaces, resource levels b) Test personnel roles and responsibilities, including both acquirer and supplier personnel, and CM and QA personnel as well as test team personnel performing the test procedures c) Test processes being implemented including both the nominal process and retest process(es) when test anomalies are encountered that require corrections d) The anomaly adjudication process to determine whether and how testing can be continued after an anomaly has occurred during test execution e) A recorded process for managing the requirements verification status for the hardware and software elements under test (e.g., fully verified, partially verified, not verified) following test completion and data analysis
Risk assessment	a) Risk identification and mitigation including consideration of risks affecting the integration activity under review
Program cost and schedule estimates	a) Current program cost estimate and relation to integration test budget b) Detailed test schedules for the planned integration test c) Review of the current program schedule showing the phasing of the planned formal test event in the overall T&E plan

C.6.4 IRR closure

Table C.5 lists the actions that should be considered for IRR closure. The responsible people listed are those most often tasked with the listed closure actions. The acquirer and supplier may agree to assign the program manager and systems engineer actions to different people or organizations depending on a given program's organizational structure. If a given program requires an IRR, the specific actions shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement. If a given program requires an IRR, responsibilities shall be assigned to people or organizations in accordance with the acquirer-supplier agreement.

Table C.5—IRR closure actions

Responsible person	IRR closure actions
Program manager	a) If funding profiles are insufficient to support development, notify user/sponsor of funding shortfall and request funding profile adjustments. b) Support development of the IRR summary report.
Systems engineer	a) Organize and supervise the responses to all action items generated during IRR. b) Support development of the IRR summary report.
Program test lead	a) Organize and supervise the detailed documentation of all action items assigned during the IRR. b) Support development of the IRR summary report.
IRR chair	a) Ensure preparation of the IRR summary report with the support of the program manager, systems engineer and program test lead. b) Sign off final approval of all action items. c) Prepare the formal IRR completion letter.
Recorder	a) Collate all action items for submission to the IRR chair. b) Prepare the IRR summary report and IRR minutes for signature and distribution by the IRR chair. c) Prepare the IRR closure letter for signature by the IRR chair.

C.7 IRR application guidance

The following is a set of observed good practices for consideration:

a) For complex systems where there are numerous subsystems or lower level elements, or where the various subsystems and elements progress at different rates, it may be appropriate to conduct multiple IRRs.

b) The request for the IRR chair should occur at least 60 days prior to conduct of the technical review.

c) If multiple IRRs are held, it is important that all conflicts or other issues arising from the results of the IRRs be resolved before conducting the TRR.

d) Program managers and product leads should tailor the IRR requirements to the specific planned tests and identified risk levels of the specific program.

e) The degree of technical review for any specific IRR is directly related to the risk level associated with performing the planned integration tests and to the importance of the test results to the overall program success.

f) Specific IRRs should be tailored according to the technical scope and risk of the hardware and software elements under test.

g) If an incremental life-cycle development model has been chosen, then the acquisition documentation will only need to be completed to the point defined in the software development plan (SDP) for the increment associated with a given IRR.

h) In order to help ensure a comprehensive and balanced assessment of all IRR work products, IRR participants from both the acquirer and supplier should include the following, as applicable:

1) Program management
2) Configuration management
3) Systems engineering
4) Software engineering
5) Hardware engineering
6) Logistics
7) Test and evaluation
8) System users
9) Cost estimating team
10) Legal counsel, if required
11) Contracting officers
12) Recorder or secretary

NOTE—These roles do not dictate that a single individual is provided for each role. A single individual may perform more than one of these roles within the team. Depending on the complexity of the system, more than one individual may also be assigned to a specific role.