9/6/2024

DOC-0BD9
NRC Docket Number: 99902106

U.S. Nuclear Regulatory Commission
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Rockville, MD 20852-2738

Subject: Radiant Submittal of "Gap Analysis for 10 CFR 50/52"

This letter submits for review the results of a regulatory gap analysis performed by Radiant as part of its pre-application activities. This submittal, Enclosure 1, is in the form of a white paper titled, "10 CFR 50/52 Gap Analysis".

The primary purpose of performing a gap analysis was to identify existing regulations that are not technically relevant to the Kaleidos reactor design. The enclosed gap analysis provides Radiant's determination of the applicability of the regulations contained in 10 CFR 50 and 10 CFR 52 associated with the Kaleidos design, and includes a discussion on items identified as not applicable, items associated with potential exemption requests, or items requiring further evaluation.

Radiant requests that the U.S. Nuclear Regulatory Commission (NRC) staff provide feedback by letter on topics for which additional discussion may be beneficial and the staff's observations on the conclusions presented in the white paper. The specific review schedule will be developed with Radiant's NRC project manager.

This letter and enclosure make no new or revised regulatory commitments.

If you have any questions regarding this submittal, please contact Chanson Yang at chanson@radiantnuclear.com or (310) 741-2931.

Sincerely,

Chanson Yang
Head of Regulatory Engineering

Cc: Stephen Philpotts, NRC Project Manager
Kevin Roche, NRC Project Manager

Title:	**10 CFR 50/52 Gap Analysis**
Subject:	**Radiant Document**
Number:	**DOC-0BD9**
Revision:	**0.2**
Author:	**Melinda Graham**
Approved By:	**Chanson Yang**
Approval Date:	**9/6/2024**

REVISION LOG

Rev.	Change Summary
0.2	Initial Release

CONTENTS

1 PURPOSE

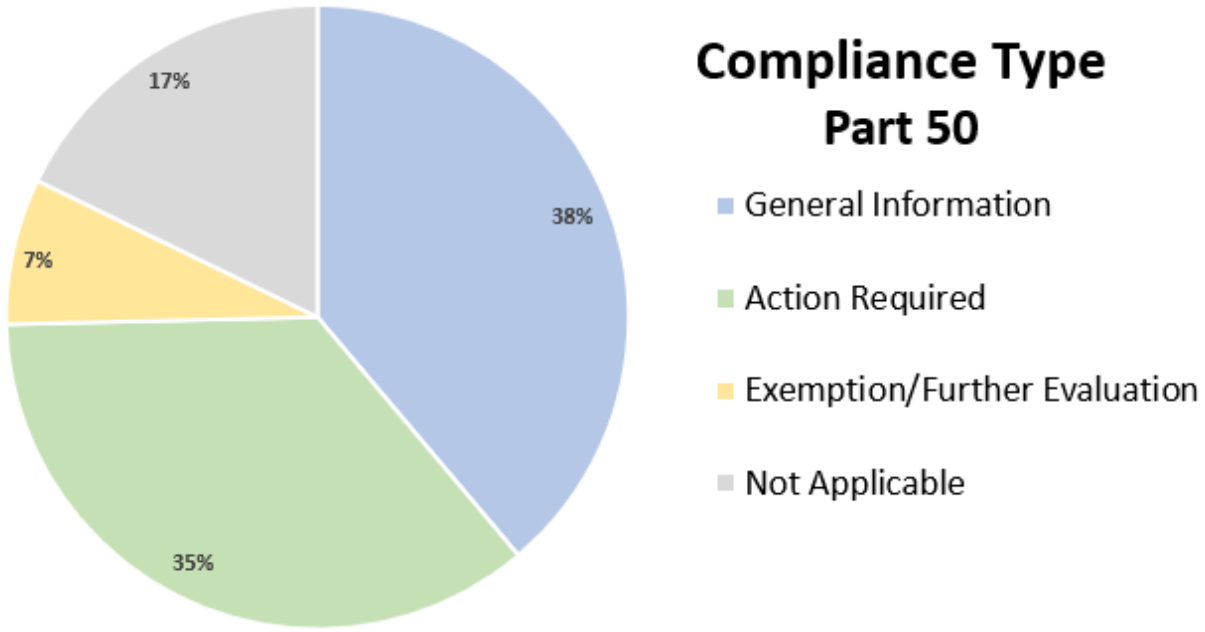
This document is a gap analysis of 10 CFR 50, Domestic Licensing of Production and Utilization Facilities and 10 CFR 52, Licenses, Certifications, and Approvals for Nuclear Power Plants against the specific requirements necessary to license both a manufacturing facility capable of operational reactor testing and deployed microreactor units for the Kaleidos reactor design.

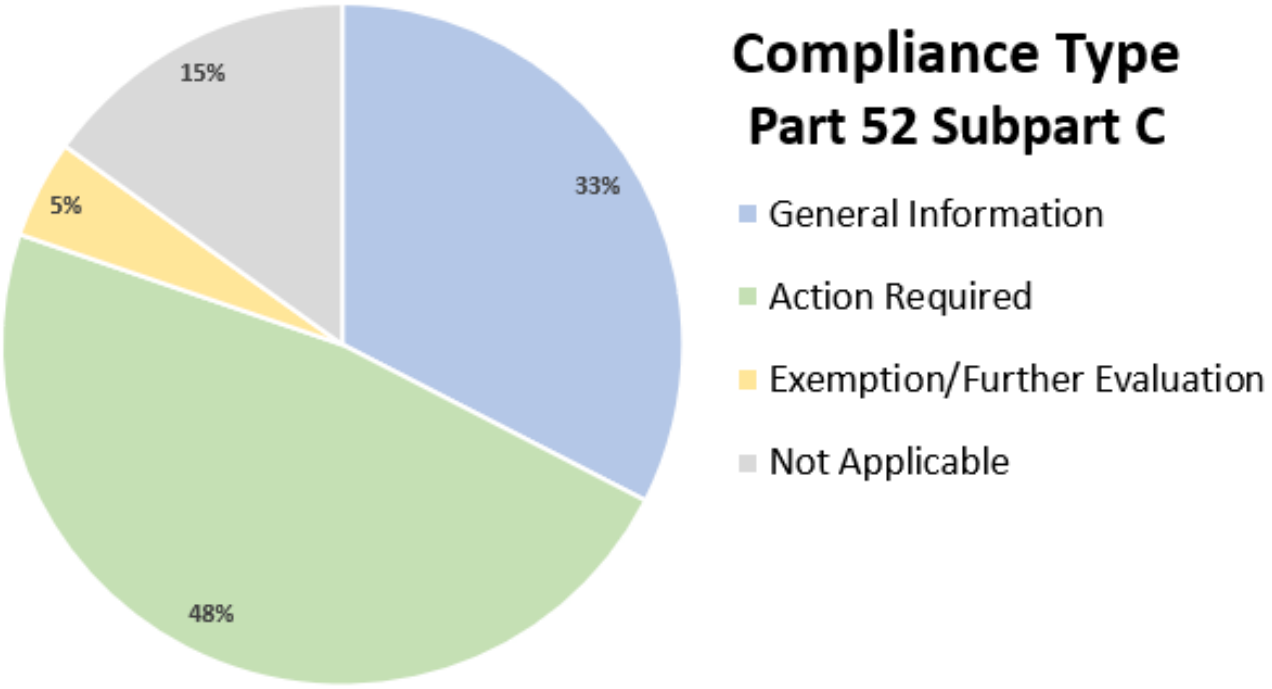
This evaluation is broken down into three subsections – the first evaluates potential gaps for utilizing a traditional licensing path (construction permit (CP)/operating license(OL)); the second evaluates potential licensing gaps for pursuing a combined operating license (COL); and the third reviews potential gaps for obtaining a manufacturing license. The purpose of this gap analysis is to better understand and establish potential licensing gaps and/or items requiring further evaluation/discussion for the available licensing options. This gap analysis does not represent any specific commitment on Radiant's behalf regarding its licensing strategy; rather it is a document that will be used to inform the licensing framework necessary to license the Kaleidos reactor.

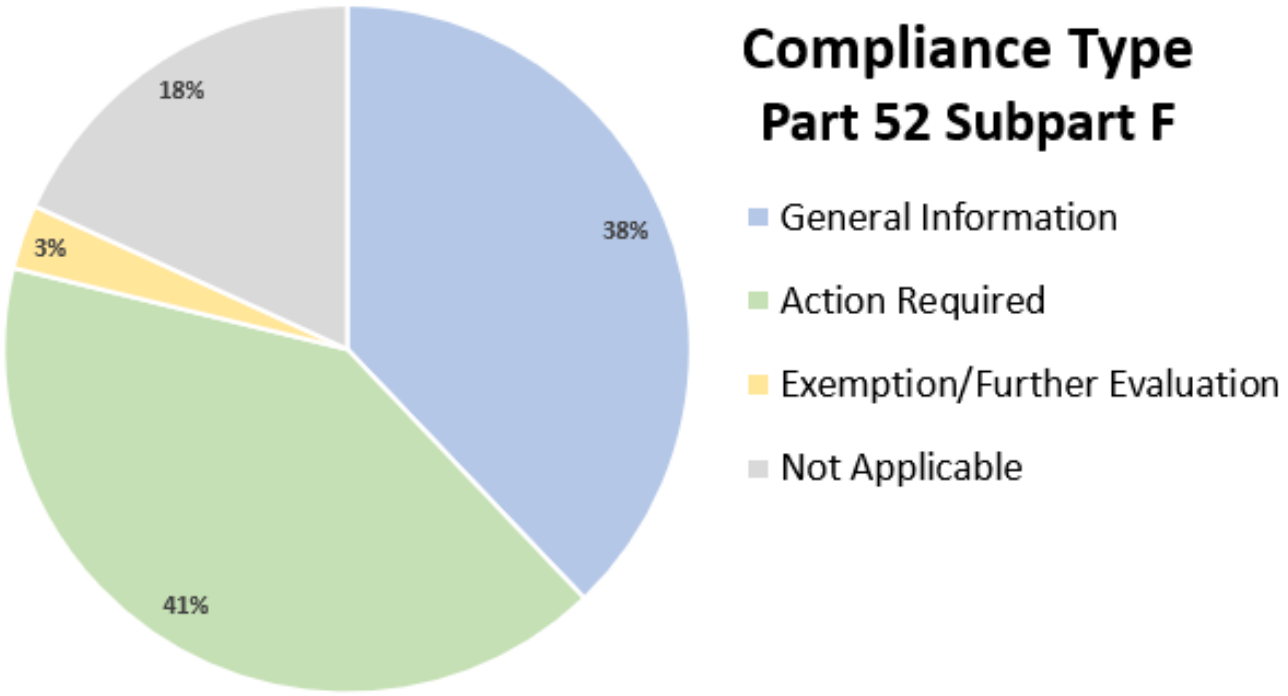
2 EVALUATION CRITERIA

The following evaluation criteria was utilized to categorize the sections and subsections of 10 CFR 50 and 10 CFR 52:

- **Action Required:** Items that need to be proven/verified/accounted for in the design and/or license application.
- **General Information:** Items associated with regulatory action or process, or represents general information that requires no specific action on Radiant's part.
- **Not Applicable:** Items that do not apply by nature of subpart or section applicability.
- **Further Evaluation / Potential Exemption:** Items that require additional evaluation, analysis, discussion, or consideration with regards to the requirement integration into the Kaleidos regulatory framework. This item also indicates sections or subsections that may require an exemption in whole or part.




Compliance Type
Part 52 Subpart C
15%
33%
5%
48%
General Information
Action Required
Exemption/Further Evaluation
Not Applicable


Compliance Type
Part 52 Subpart F
18%
38%
3%
41%
General Information
Action Required
Exemption/Further Evaluation
Not Applicable

3 GENERAL SUMMARY

Radiant is actively working towards licensing a microreactor design to be manufactured, fueled, tested and then shipped to a remote site for operation and use. At the end of fuel life, the unit will be shipped back to the manufacturing facility for refuel. The unit will ship with fuel following testing at the manufacturing location, and will be ready for operation as soon as it reaches its intended destination. The licensing framework for the Kaleidos design needs to include accommodations to allow for the fuel load and testing at the manufacturing location, subsequent shipment and operation at designated sites, and return shipment of a unit containing spent fuel. Units may also be temporarily deployed to an operating site (i.e., relocated to a new or multiple new locations prior to end of fuel life). Units are anticipated to be deployed in either single units (standalone), or multiple units that would operate in parallel. At end of fuel life, it is possible that a replacement unit is deployed and placed into operation before the unit identified for refuel is removed.

10 CFR 50 and 10 CFR 52 were evaluated with consideration for utilizing a traditional licensing approach (construction permit/operating license) or a combined licensing approach, potentially paired with a manufacturing license. Each path was reviewed independently of the other (e.g., a manufacturing license was not assumed as a precursor to a combined operating license). It is understood that information can be referenced from one license to another and/or combined into a single license.

There were several items identified within 10 CFR 50 and 10 CFR 52 that may require a specific exemption for licensing the operational testing facility and/or the reactor unit; this determination is subject to change and may be reflected in a revision to this document, or during submission of the eventual application. Radiant is requesting discussion and feedback from the staff on the contents of the gap analysis with particular emphasis on potential exemptions and items identified requiring further evaluation to ensure regulatory alignment as early as possible in the pre-application process.

This gap analysis is broken out into three sub-sections. Section 4 identifies items related to licensing the portion of the manufacturing facility dedicated to reactor testing and / or deployed units utilizing the traditional construction permit/operating license process under Part 50. Section 5 identifies items related to licensing under the combined license process (Part 52 Subpart C). Section 6 identifies items related to licensing a manufacturing facility under Part 52 Subpart F that allows for the manufacture of the Kaleidos reactor, including its associated balance of plant, however does not include operation of any unit (operation of reactors is not permitted under a Part 52 Subpart F license).

4 GAP ANALYSIS 10 CFR 50: CONSTRUCTION PERMIT/OPERATING LICENSE

This subsection describes the licensing process Radiant is anticipating to pursue if utilizing a traditional licensing approach (construction permit and operating license) for its licensing framework. This approach could apply to either the portion or area of the manufacturing facility that would conduct unit testing OR the deployed unit(s).

4.1 General Provisions

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.1	Basis, purpose and procedures	General Information	
50.2	Definitions	General Information	NOTE: Additional definitions may be identified throughout the pre-application process that may require further evaluation for applicability.
	Construction	Further Evaluation	Further evaluation and discussion on a potential modification to the definition of construction and its relationship to Radiant's regulatory framework is necessary. Currently, the definition of construction in 10 CFR 21.3 and 50.2 lists "placement, erection, installation" included within the scope of construction. Per 10 CFR 50.56, completion of construction is necessary to convert a construction permit to an operating license. For deployed units, if a Part 50 licensing approach is utilized, the operating license would need to be issued prior to conducting operational testing at the manufacturing facility (prior to deployment to site location), therefore the traditional applications of "placement, erection, installation" will not yet have occurred.
50.3	Interpretations	General Information	
50.4	Written communications	General Information	
50.5	Deliberate misconduct	General Information	
50.7	Employee protection	General Information	
50.8	Information collection requirements: OMB approval	General Information	

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.9	Completeness and accuracy of information	General Information	

4.2 Requirements of License, Exceptions

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.10	License required; limited work authorization	General Information	NOTE: Action required if Radiant opts to pursue a limited work authorization for a Part 50 CP/OL OR a Part 52 Subpart C COL for deployed unit placement; an early site permit, limited work authorization, and / or construction permit is not required to allow work start for a manufacturing facility.
50.11	Exceptions and exemptions from licensing requirements	General Information	
50.12	Specific exemptions	General Information	
50.13	Attacks and destructive acts by enemies of the Unites States; and defense activities	General Information	

4.3 Classification and Description of Licenses

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.20	Two classes of licenses	General Information	
50.21	Class 104 licenses; for medical therapy and research and development facilities	Not Applicable	Facility will not be utilized for medical therapy and/or research and development.
50.22	Class 103 licenses; for commercial and industrial facilities	General Information	
50.23	Construction permits	General Information	

4.4 Applications for Licenses, Certifications, and Regulatory Approvals; Form; Contents; Ineligibility of Certain Applicants

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.30	Filing of applications for licenses; oath or affirmation	Action Required	
50.31	Combining applications	General Information	
50.32	Elimination of repetition	General Information	
50.33	Contents of applications; general information	Action Required	NOTE: Additional discussion on section 50.33(f)(2) may be necessary to establish reasonable assurance for the duration of the operating license compared to the duration of unit operation prior to refuel.
50.34	Contents of applications; technical information		
(a)(1)	PSAR safety assessment of site and facility	Action Required	NOTE: In lieu of using section 50.34(a)(1)(i), section 50.34(a)(1)(ii) would be used to inform the application, however it is not considered applicable as Kaleidos is not considered a stationary reactor.
(a)(2)	PSAR summary description of the facility	Action Required	
(a)(3)	PSAR preliminary design of the facility	Action Required	
(a)(4)	PSAR preliminary analysis of SSCs	Action Required	This section is categorized as 'action required,' except for references to 10 CFR 50.46 and 50.46a, which are not applicable and therefore will not be addressed.
(a)(5)	PSAR preliminary technical specifications	Action Required	
(a)(6)	PSAR preliminary training and conduct of operations	Action Required	
(a)(7)	PSAR quality assurance program	Action Required	
(a)(8)	PSAR research and development	Action Required	
(a)(9)	PSAR technical qualifications	Action Required	
(a)(10)	PSAR emergency planning	Action Required	Radiant intends to submit emergency planning information per 10 CFR 50.160.
(a)(11)	PSAR multi-unit sites	Action Required	

Part 50 CP/OL		Compliance Type	Compliance Rationale
(a)(12)	PSAR seismic criteria	Action Required	Refer to Appendix S for additional comment.
(a)(13)	PSAR aircraft assessment	Potential Exemption	Radiant is considering an exemption for aircraft assessment for the Kaleidos micro reactor design. The Kaleidos reactor unit, during testing at the manufacturing facility and once installed at its delivery location, represents a fraction of a power reactors footprint, in both physical size and in radionuclide inventory. The risk and potential consequence of an aircraft impact to a sited microreactor is significantly less than a traditional power reactor. Aircraft impact assessments are not required for non-power reactors per the applicability section of 10 CFR 50.150; the radionuclide inventory of Kaleidos more closely aligns with a research and test reactor.
(b)(1)	FSAR environmental and meteorological monitoring programs	Action Required	
(b)(2)	FSAR description of SSCs	Action Required	
(b)(3)	FSAR kinds and quantities of radioactive materials	Action Required	
(b)(4)	FSAR analysis of SSCs	Action Required	This section is categorized as 'action required,' except for references to 10 CFR 50.46 and 50.46a, which are not applicable and therefore will not be addressed.
(b)(5)	FSAR research and development	Action Required	
(b)(6)	FSAR facility operation	Action Required	NOTE: Radiant intends to comply with section 10 CFR 50.160 for emergency planning.
(b)(7)	FSAR technical qualifications	Action Required	
(b)(8)	FSAR operation requalification	Action Required	
(b)(9)	FSAR pressurized thermal shock	Not Applicable	Pressurized thermal shock events are applicable to systems that contain water; the Kaleidos design does not utilize water in any capacity. This section has been deemed not applicable to the Kaleidos design.
(b)(10)	FSAR seismic criteria	Action Required	Refer to Appendix S for additional comment.

Part 50 CP/OL		Compliance Type	Compliance Rationale
(b)(11)	FSAR siting criteria	Action Required	
(b)(12)	FSAR aircraft assessment	Potential Exemption	Radiant is considering an exemption for aircraft assessment for the Kaleidos micro reactor design. The Kaleidos reactor unit, during testing at the manufacturing facility and once installed at its delivery location represents a fraction of a power reactors footprint, in both physical size and in radionuclide inventory. The risk and potential consequence of an aircraft impact to a sited microreactor is significantly less than a traditional power reactor. Aircraft impact assessments are not required for non-power reactors per the applicability section of 10 CFR 50.150; the radionuclide inventory of Kaleidos more closely aligns with a research and test reactor.
(c)	Physical Security Plan	Action Required	
(d)	Safeguard Contingency Plan	Action Required	
(e)	Protection against Unauthorized Disclosure	Action Required	
(f)	Three Mile Island	Further Evaluation	Requirements need further review to establish technical relevancy to the Kaleidos design, and may result in request for exemption(s).
(g)	Combustible Gas Control	Not Applicable	Applicable to boiling or pressurized water nuclear power reactor only.
(h)	Conformance with the Standard Review Plan	Not Applicable	Applicable to light water reactors only.
(i)	Mitigation of beyond-design-basis events	Further Evaluation	Further evaluation is necessary to address beyond design basis events for the Kaleidos micro reactor design. Refer to 10 CFR 50.155 for more detail.
50.34a	Design objectives for equipment to control releases of radioactive material in effluents – nuclear power reactors	Not Applicable	The Kaleidos reactor unit does not have any direct interaction points with the environment, such as coolant discharge, air cooling towers, or exhaust stacks.
50.35	Issuance of construction permits	General Information	
50.36	Technical specifications	Action Required	

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.36a	Technical specifications on effluents from nuclear power reactors	Not Applicable	The Kaleidos reactor unit does not have any direct interaction points with the environment, such as coolant discharge, air cooling towers, or exhaust stacks.
50.36b	Environmental conditions	Action Required	
50.37	Agreement limiting access to Classified Information	Action Required	
50.38	Ineligibility of certain applicants	General Information	
50.39	Public inspection of applications	General Information	

4.5 Standards for Licenses, Certifications, and Regulatory Approvals

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.40	Common standards	General Information	
50.41	Additional standards for class 104 licenses	Not Applicable	Facility will not be utilized for medical therapy and/or research and development.
50.42	Additional standards for class 103 licenses	General Information	
50.43	Additional standards and provisions affecting class 103 licenses and certifications for commercial power		
(a)	NRC notice to the public	General Information	NOTE: An exemption may be considered with regard to section 50.43(a)(3) modifying the 4 week posting requirement.
(b)	Conflicting applications	General Information	
(c)	Interstate commerce	General Information	
(d)	Government agency energy production	General Information	
(e)	Applicants who design differ significantly from light-water reactor designs licensed before 1979	Action Required	
50.44	Combustible gas control for nuclear power reactors		
(a)	Definitions	General Information	

Part 50 CP/OL		Compliance Type	Compliance Rationale
(b)	Requirements for currently-licensed reactors	Not Applicable	Not currently licensed
(c)	Requirements for future water-cooled reactor applicants and licensees	Not Applicable	Applicable to boiling or pressurized water nuclear power reactor only.
(d)	Requirements for future non water-cooled reactors applicants and certain water-cooled reactor applicants and licensees	Action Required	Radiant is planning to provide information detailing whether accidents involving combustible gases are technically relevant to the Kaleidos design.
50.45	Standards for construction permits, operating licenses, and combined licenses	Action Required	
50.46	Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors	Not Applicable	Applicable to light water reactors only.
50.46a	Acceptance criteria for reactor coolant system venting systems	Not Applicable	The Kaleidos design utilizes a passive cooling system.
50.47	Emergency plans		
(a)	NRC's finding	General Information	
(b)	Onsite and offsite emergency response plans	Not Applicable	Radiant is intending to submit an Emergency Plan compliant with 10 CFR 50.160 per 10 CFR 50.34(b)(6)(v)(B).
(c)	Inability to meeting emergency planning standards	General Information	
(d)	Emergency preparedness for fuel loading/lower power testing	General Information	
(e)	Fuel load/operation restriction	General Information	
(f)	Applicability of prior sections	General Information	
50.48	Fire protection	Action Required	NOTE: Radiant is still evaluating the option to utilize risk-informed and performance-based alternatives to compliance with listed NFPA codes.
50.49	Environmental qualification of electric equipment important to safety for nuclear power plants	Action Required	

4.6 Issuance, Limitations, and Conditions of Licenses and Construction Permits

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.50	Issuance of licenses and construction permits	General Information	
50.51	Continuation of license	General Information	
50.52	Combining licenses	General Information	
50.53	Jurisdictional limitations	General Information	
50.54	Conditions of licenses		
(a)	Quality assurance program	Action required	
(b)	Licensed SNM	General Information	
(c)	Rights of transfer	General Information	
(d)	Suspension and recapture	General Information	
(e)	Revocation, suspension, modification and amendment	General Information	
(f)	Information request	General Information	
(g)	Antitrust	General Information	
(h)	Subject to provisions of the Act	General Information	
(i)	Manipulation of controls & requalification program	Action Required	NOTE: A separate gap analysis will be submitted that addresses the requirements outlined in 10 CFR Part 55.
(j)	Operations affecting reactivity	Action Required	NOTE: A separate gap analysis will be submitted that addresses the requirements outlined in 10 CFR Part 55.
(k)	Presence of operator & senior operator	Action Required	NOTE: A separate gap analysis will be submitted that addresses the requirements outlined in 10 CFR Part 55.
(l)	Responsibility for licensed operators	Action Required	NOTE: A separate gap analysis will be submitted that addresses the requirements outlined in 10 CFR Part 55.
(m)	Staffing requirements	Further Evaluation	A separate gap analysis will be submitted to address the requirements outlined in 10 CFR Part 55; additional evaluation is needed with regards to minimum staffing requirements both related to number of qualified staff (operator/senior operator) and location staff is assigned.

Part 50 CP/OL		Compliance Type	Compliance Rationale
(n)	Technical specifications	Action Required	
(o)	Reactor containments for water cooled reactors	Not Applicable	
(p)	Changes to safeguards contingency plan procedures	Action Required	NOTE: A separate gap analysis will be submitted that addresses the requirements outlined in 10 CFR Part 73.
(q)	Changes to emergency plans – Definitions	Action Required	NOTE: 10 CFR 50.54(q)(2)(ii) and 50.54(q)(3)(ii) apply to the Kaleidos reactor unit as it is a non-light-water reactor.
(r)	Reserved	Not Applicable	
(s)	Reasonable assurance for emergency preparedness	General Information	
(t)	Development and training for emergency preparedness	Action Required	
(u)	Reserved		
(v)	Protection of Safeguards information	Action Required	
(w)	Insurance	Further Evaluation	Further evaluation is required to establish reasonable insurance minimums and coverages for deployed reactor units.
(x)	Emergency action	General Information	
(y)	Senior operator oversight for emergency action	General Information	
(z)	Notification	Action Required	
(aa)	Federal Water Pollution Control Act	Action Required	
(bb)	Notification of cessation of operation	General Information	
(cc)	Bankruptcy	General Information	
(dd)	Actions during a national security emergency	General Information	
(ee)	Receipt of material	General Information	
(ff)	Seismic event	Action Required	
(gg)	Emergency planning exercise	Further Evaluation	The scope of the emergency planning requirements for deployed units requires further analysis and evaluation. Refer to

Part 50 CP/OL		Compliance Type	Compliance Rationale
			section 10 CFR 50.160 for additional notes.
(hh)	Procedures to address an aircraft threat	Potential Exemption	Radiant is considering an exemption for aircraft assessment for the Kaleidos micro reactor design. The Kaleidos reactor unit, both during testing at the manufacturing facility and once installed at its delivery location represents a fraction of a power reactors footprint, in both physical size and in radionuclide inventory. The risk and potential consequence of an aircraft impact to a sited microreactor is significantly less than a traditional power reactor. Aircraft impact assessments are not required for non-power reactors per the applicability section of 10 CFR 50.150. Additionally, there are portions of this requirement that are not feasible for remote units (e.g., identifying measures to reduce visual discrimination of the area in the event of an aircraft threat notification).
(ii)	Reserved	Not Applicable	
(jj)	SSC's subject to codes and standards	Action Required	
50.55	Conditions of construction permits, early site permits, combined licenses, and manufacturing licenses	Action Required	
50.55a	Codes and standards	Action Required	NOTE: Review of this section and its applicability will be ongoing throughout the application process and may require further evaluation for modification.
50.56	Conversion of construction permit to licenses; or amendment of license	General Information	
50.57	Issuance of operating license	General Information	
50.58	Hearings and report of the Advisory Committee on Reactor Safeguards	General Information	
50.59	Changes, tests and experiments	Action Required	
50.60	Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation	Not Applicable	Applicable to light water reactors only.

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.61	Fracture toughness requirements for protection against pressurized thermal shock events	Not Applicable	Pressurized thermal shock events are applicable to systems that contain water; the Kaleidos design does not utilize water in any capacity. This section has been deemed not applicable to the Kaleidos design.
50.61a	Alternate fracture toughness requirements for protection against pressurized thermal shock events	Not Applicable	Pressurized thermal shock events are applicable to systems that contain water; the Kaleidos design does not utilize water in any capacity. This section has been deemed not applicable to the Kaleidos design.
50.62	Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants	Not Applicable	Applicable to light water reactors only.
50.63	Loss of all alternating current power	Not Applicable	Applicable to light water reactors only.
50.64	Limitations on the use of highly enriched uranium (HEU) in domestic non-power reactors	Not Applicable	Applicable to non-power reactors only.
50.65	Requirements for monitoring the effectiveness of maintenance at nuclear power plants	Action Required	
(a)	Applicability and requirements	Further Evaluation	Further evaluation is required for section 10 CFR 50.65(a)(3) related to the 24-month preventative maintenance evaluation requirement to ensure maintenance of a fleet of units is appropriately addressed.
(b)	Program Scope	Action Required	
(c)	Implementation	Not Applicable	Applied to facilities with issued licenses prior to July 10, 1996.
50.66	Requirements for thermal annealing of the reactor pressure vessel	Not Applicable	Applicable to light water reactors only.
50.67	Accident source term	Not Applicable	Applicable to licenses issued prior to 1997 only.
50.68	Criticality accident requirements	Potential Exemption	Radiant is considering an exemption for item (b)(7) related to enrichment level limit. The Kaleidos reactor will utilize TRISO fuel, and as such, will be enriched greater

Part 50 CP/OL	Compliance Type	Compliance Rationale
		than 5 wt% U_{235} (but remain less than 20 wt% U_{235}).

4.7 Inspections, Records, Reports, Notifications

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.69	Risk-Informed categorization and treatment of structures, systems, and components for nuclear power reactors	Action Required	NOTE: As risk-informed categorization is reviewed against the design, further evaluation for a modification to this section may be necessary.
50.70	Inspections	General Information	
50.71	Maintenance of records, making of reports		
(a)	Records and reports	Action Required	
(b)	Annual financial report	Action Required	
(c)	Record retention	Action Required	
(d)	Record requirements	General Information	
(e)	FSAR update	Action Required	
(f)	FSAR update for manufactured reactor	Action Required	
(g)	Cessation of operation	General Information	
(h)	PRA Requirement	Further Evaluation	Further evaluation of this requirement is necessary to consider risk informed, performance-based applications, potentially encompassing a fleet of microreactor units.
50.72	Immediate notification requirements for operating nuclear power reactors	Action Required	NOTE: There are items specific to this section that are not applicable to the Kaleidos design (e.g., emergency core cooling system). These items would be not addressed within the license application and an exemption would not be sought; based on the wording of the section, the item does not apply. This section may require further review in the future to ensure a risk informed, performance-based approach to reporting requirements.

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.73	License event report system	Action Required	NOTE: There are items specific to this section that are not applicable to the Kaleidos design (e.g., emergency core cooling system). These items would be not addressed within the license application and an exemption would not be sought; based on the wording of the section, the item does not apply. This section may require review in the future to ensure a risk informed, performance-based approach to reporting requirements.
50.74	Notification of change in operator or senior operator status	Action Required	
50.75	Reporting and recordkeeping for decommissioning planning	Action Required	Additional interface is required to define applicable requirements for the Kaleidos design.
50.76	Licensee's change of status; financial qualifications	Action Required	

4.8 US/IAEA Safeguards Agreement

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.78	Facility information and verification	General Information	

4.9 Transfer of Licenses – Creditors Rights – Surrender of Licenses

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.80	Transfer of licenses	General Information	
50.81	Creditor regulations	General Information	
50.82	Termination of license	General Information	
50.83	Release of part of a power reactor facility or site for unrestricted use	General Information	

4.10 Amendment of License or Construction Permit at Request of Holder

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.90	Application for amendment of license, construction permit, or early site permit	General Information	
50.91	Notice for public comment; State consultation	General Information	
50.92	Issuance of amendment	General Information	

4.11 Appendix A, Reportable Safety Events

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.100	Revocation, suspension, modification of licenses, permits, and approvals for cause	General Information	
50.101	Retaking possession of special nuclear material	General Information	
50.102	Commission order for operation after revocation	General Information	
50.103	Suspension and operation in war or national emergency	General Information	

4.12 Backfitting

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.109	Backfitting	General Information	

4.13 Enforcement

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.110	Violations	General Information	
50.111	Criminal penalties	General Information	

4.14Additional Standards for Licenses, Certifications, and Regulatory Approvals

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.120	Training and qualification of nuclear power plant personnel	Action Required	
50.150	Aircraft impact assessment	Potential Exemption	Radiant is considering an exemption for aircraft assessment for the Kaleidos micro reactor design. The Kaleidos reactor unit, during testing at the manufacturing facility and once installed at its delivery location, represents a fraction of a power reactors footprint, in both physical size and in radionuclide inventory. The risk and potential consequence of an aircraft impact to a sited microreactor is significantly less than a traditional power reactor. Aircraft impact assessments are not required for non-power reactors per the applicability section of 10 CFR 50.150; the radionuclide inventory of Kaleidos more closely aligns with a research and test reactor.
50.155	Mitigation of beyond-design-basis events		
(a)	Applicability	General Information	Mitigation of beyond design basis events is applicable, per this section, to the Kaleidos design.
(b)	Strategies and guidelines		
(b)(1)	Mitigation strategies for beyond design basis external events	Further Evaluation	Further evaluation and discussion is necessary to ensure an appropriate boundary is established for mitigation strategies for beyond design basis events. For example, the design basis natural phenomena hazard will utilize bounding cases to allow flexibility for unit siting. Additionally, the use of offsite assistance and resources requires evaluation and discussion; Kaleidos units are designed to operate in remote environments where such infrastructure may not exist.
(b)(2)	Extensive damage mitigation guidelines	Further Evaluation	Further evaluation and discussion is necessary regarding extensive damage scenarios and potential accident consequences as it relates to the Kaleidos design. The Kaleidos “plant” and site

Part 50 CP/OL		Compliance Type	Compliance Rationale
			infrastructure is significantly different then that required for a traditional stationary nuclear power plant. Passive cooling is utilized by the Kaleidos reactor unit such that a restoration of cooling in extreme conditions is not required to maintain the reactor in a safe state.
(c)	Equipment	Action Required	NOTE: This item correlates to any evaluation/determination in subsection (a) and (b).
(d)	Training requirements	Action Required	The Kaleidos units are designed to operate with minimal to no human interaction. Personnel monitor operating conditions from remote control rooms.
(e)	Spent fuel pool monitoring	Not Applicable	
(f)	Documentation of changes	General Information	
(g)	Implementation	General Information	
(h)	Withdrawal of orders and removal of license conditions	Not Applicable	

4.15Additional Standards for Licenses, Certifications, and Regulatory Approvals

Part 50 CP/OL		Compliance Type	Compliance Rationale
50.160	Emergency preparedness for small modular reactors, non-light-water reactors, and non-power production or utilization facilities		
(a)	Definitions	General Information	
(b)	Requirements	Action Required	
(c)	Implementation	Potential Exemption	Radiant is considering a modification to the requirement for an initial exercise to be performed 2 years prior to the initial loading of fuel. To support an efficient and effective licensing process, an exercise should be representative of a fleet of units and dependent upon the processes in place to ensure preparedness rather than associated with initial fueling.

Part 50 CP/OL		Compliance Type	Compliance Rationale
Appendix A	General Design Criteria for Nuclear Power Plants	General Information	NOTE: The Kaleidos design is not a water cooled reactor as specified in the introduction section of Appendix A. Radiant considers the requirements listed in Appendix A as information only; an exemption is considered not required for any of the items listed in Appendix A that are not implemented by Radiant (ref. ML 23277A139). Currently, Radiant is utilizing RG 1.232, Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors to inform their PDC approach.
Appendix B	Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants	Action Required	
Appendix C	A Guide for the Financial Data and Related Information Required to Establish Financial Qualifications for Construction Permits and Combined Licenses	General Information	
Appendix D	Reserved	Not Applicable	Reserved
Appendix E	Emergency Planning and Preparedness for Production and Utilization Facilities	Not Applicable	Radiant intends to comply with section 50.160.
Appendix F	Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities	Not Applicable	Applicable to Fuel Reprocessing and Related Waste Management facilities only.
Appendix G	Fracture Toughness Requirements	Not Applicable	Applicable to light water reactors only.
Appendix H	Reactor Vessel Material Surveillance Program Requirements	Not Applicable	Applicable to light water reactors only.
Appendix I	Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion “As Low as in Reasonably Achievable” for Radioactive Material in Light-Water0Cooled Nuclear Power Plants	Not Applicable	Applicable to light water reactors only; this Appendix may be used to inform or guide design objectives or LCO’s related to ALARA.

Part 50 CP/OL		Compliance Type	Compliance Rationale
Appendix J	Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors	Not Applicable	Applicable to water-cooled reactors only.
Appendix K	ECCS Evaluation Models	Not Applicable	Applicable to light water reactors only.
Appendix L	Reserved	Not Applicable	Reserved
Appendix M	Reserved	Not Applicable	Reserved
Appendix N	Standardization of Nuclear Power Plant Designs: Permits to Construct and Licenses to Operate Nuclear Power Reactors of Identical Design at Multiple Sites	General Information	
Appendix O	Reserved	Not Applicable	Reserved
Appendix P	Reserved	Not Applicable	Reserved
Appendix Q	Pre-application Early Review of Site Suitability Issues	Not Applicable	Radiant is not intending on submitting for an early site permit; this Appendix may be used to inform or guide siting suitability.
Appendix R	Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979	Not Applicable	Applicable to facilities operating prior to January 1, 1979 only.
Appendix S	Earthquake Engineering Criteria for Nuclear Power Plants	Action Required	A gap analysis will be performed for siting requirements (10 CFR 100) that will address the use of publicly available data for use as inputs to analyses.

5 GAP ANALYSIS 10 CFR 52: SUBPART C COMBINED OPERATING LICENSE

This subsection describes the licensing process Radiant is anticipating to pursue if utilizing a combined licensing approach to its licensing framework for the Kaleidos reactor. Various sections of Part 52 Subpart C refer back to sections of Part 50. Referenced sections of Part 50 may be applicable as general information, or very obviously not applicable to the Kaleidos design (e.g., applicable only to a light water reactor), and are not included in this portion of the gap analysis. This approach could apply to the portion or area of the manufacturing facility that would conduct unit testing OR the deployed unit(s).

5.1 General Provisions

Part 52 COL		Compliance Type	Compliance Rationale
52.0	Scope; applicability of 10 CFR Chapter 1 provisions	General Information	
52.1	Definitions	Further Evaluation	Refer to Section 4.
52.2	Interpretations	General Information	
52.3	Written communications	General Information	
52.4	Deliberate misconduct	General Information	
52.5	Employee protections	General Information	
52.6	Completeness and accuracy of information	General Information	
52.7	Specific exemptions	General Information	
52.8	Combining licenses; elimination of repetition	General Information	
52.9	Jurisdictional limits	General Information	
52.10	Attacks and destructive acts	General Information	
52.11	Information collection requirements; OMB approval	General Information	

5.2 Subpart C, Combined Operating License

Part 52 COL		Compliance Type	Compliance Rationale
52.71	Scope of subpart	General Information	

Part 52 COL		Compliance Type	Compliance Rationale
52.73	Relationship to other subparts	General Information	
52.75	Filing of applications	General Information	
52.77	Contents of applications; general information	Action Required	Referenced to 50.33 (refer to section 4 for any amplifying notes).
52.79	Contents of applications; technical information in final safety analysis report		
(a)(1)	Site Characteristics	Action Required	
(a)(2)	System, Structures and Components (SSCs)	Action Required	
(a)(3)	Radioactive Material Inventory	Action Required	
(a)(4)	Design Criteria and Design Bases	Action Required	NOTE: RG 1.232 has been used to inform the principal design criteria for the Kaleidos reactor. Appendix A is utilized for reference only.
(a)(5)	SSC Performance and Analysis	Action Required	NOTE: Analysis for ECCS loss of cooling accidents per section 50.46 and 50.46a is not required; reactor is not a light water reactor.
(a)(6)	Fire Protection	Action Required	Reference to 50.48 (refer to section 4 for any amplifying notes)
(a)(7)	Thermal Shock Protection	Not Applicable	Pressurized thermal shock events are applicable to systems that contain water; the Kaleidos design does not utilize water in any capacity. This section has been deemed not applicable to the Kaleidos design.
(a)(8)	Combustible Gas Control	Action Required	Referenced to 50.44 (refer to section 4 for any amplifying notes).
(a)(9)	Coping Analysis	Not Applicable	Applicable to light water reactors only, per 10 CFR 50.63.
(a)(10)	Electrical Equipment Qualification	Action Required	Referenced to 50.49.
(a)(11)	ASME BPV Code Compliance	Action Required	Referenced to 50.55a. NOTE: Per 52.79(a)(11), only ASME Boiler and Pressure Vessel Code (50.55a(a)(i), (ii), (iii)) and the ASME Code for Operation and Maintenance of Nuclear Power Plants (50.55a(a)(iv)) are required.

Part 52 COL		Compliance Type	Compliance Rationale
(a)(12)	Containment Leak Testing	Not Applicable	Appendix J is applicable to light-water cooled reactors; would not apply to the Kaleidos application.
(a)(13)	Material Surveillance	Not Applicable	Appendix H is applicable to light water reactors only.
(a)(14)	Operator Training	Action Required	
(a)(15)	Maintenance Program	Action Required	Referenced to 50.65.
(a)(16)	Effluent Monitoring	Not Applicable	Referenced to 50.34a (refer to section r of any amplifying notes).
(a)(17)	Three Mile Island Requirements xii, ix,v	Further Evaluation	Requirements need further review to establish technical relevancy to the Kaleidos design, and may result in request for exemption(s).
(a)(18)	Risk Informed SSC Categorization	Action Required	Referenced to 50.69 (refer to section 4 for any amplifying notes).
(a)(19)	Earthquake Criteria	Action Required	
(a)(20)	NUREG-0933 Issues	Action Required	NOTE: Additional Evaluation required for NUREG-0933 requirements.
(a)(21)	Emergency Plans	Action Required	NOTE: Emergency Plan will comply with 50.160.
(a)(22)	Emergency Plan certification	General Information	
(a)(23)	Reserved	Not Applicable	
(a)(24)	Advanced Reactor Safety Feature Verification	Action Required	Referenced to 50.43(e).
(a)(25)	Quality Program	Action Required	
(a)(26)	Organizational Structure	Action Required	
(a)(27)	Administrative Safety Controls	Action Required	
(a)(28)	Preoperational Testing	Action Required	
(a)(29)	Normal Operating Plans	Action Required	
(a)(30)	Technical Specifications	Action Required	Referenced to 50.36.
(a)(31)	Construction Hazards for Multi-Unit Sites	Action Required	
(a)(32)	Technical Qualifications	Action Required	

Part 52 COL		Compliance Type	Compliance Rationale
(a)(33)	Training Program	Action Required	Referenced to 50.120.
(a)(34)	Operator Requalification Program	Action Required	
(a)(35)	Physical Security Plan	Action Required	
(a)(36)	Security Plans	Action Required	NOTE: Radiant may consider potential exemptions for requirements outlined in Part 73. This will be identified in the Part 73 gap analysis, and may result in update to the Part 50/52 gap analysis.
(a)(37)	Operating Experience Insight	Action Required	
(a)(38)	LWR Design Features	Not Appliable	Applicable to light water reactors only.
(a)(39)	Radiation Protection Program	Action Required	
(a)(40)	Fire Protection Program	Action Required	Referenced to 50.48 (refer to section 4 or any amplifying notes).
(a)(41)	LWR SRP Evaluation	Not Applicable	Applicable to light water reactors only.
(a)(42)	Risk Reduction for ATWS Events for LWRs	Not Applicable	Applicable to light water reactors only.
(a)(43)	Criticality Requirements	Potential Exemption	Referenced to 50.68.
(a)(44)	Fitness-for-duty Program	Action Required	
(a)(45)	Minimization of Contamination	Action Required	
(a)(46)	Description of PRA and results	Action Required	
(a)(47)	Aircraft Impact Assessment	Potential Exemption	Referenced to 50.150 (refer to section 4 for any amplifying notes).
(b)	Early Site Permit Requirements	Not Applicable	Radiant will not be seeking an Early Site Permit.
(c)	Standard Design Approval Requirements	Not Applicable	Radiant will not be seeking a Standard Design Approval at this time.
(d)	Standard Design Certification Requirements	Not Applicable	Radiant will not be seeking a Standard Design Certification at this time.
(e)	Manufacturing License Approval Requirements	Action Required	
(f)	Safeguards Information Protection	Action Required	
52.80	Contents of applications; additional technical information	Action Required	

Part 52 COL		Compliance Type	Compliance Rationale
52.81	Standards for review of applications	General Information	
52.83	Finality of referenced NRC approvals; partial initial decision on stie suitability	General Information	
52.85	Administrative review of applications; hearings	General Information	
52.87	Referral to the Advisory Committee on Reactor Safeguards (ACRS)	General Information	
50.89	Reserved	Not Applicable	
52.91	Authorization to conduct limited work authorization activities	General Information	
52.93	Exemptions and variances	General Information	
52.97	Issuance of combined licenses	General Information	
52.98	Finality of combined licenses	General Information	
52.99	Inspection during construction; ITAAC schedules and notifications; NRC notices	Action Required	NOTE: ITAAC will likely be based primarily on facility specific features as a design certification will not exist for the Kaleidos design at this time. If a manufacturing license is obtained, ITAAC could be derived from the manufacturing license.
52.103	Operation under a combined license	Action Required	
52.104	Duration of combined license	General Information	
52.105	Transfer of combined license	General Information	
52.107	Application for renewal	General Information	
52.109	Continuation of combined license	General Information	
52.110	Termination of license	General Information	

6 GAP ANALYSIS 10 CFR 52: SUBPART F MANUFACTURING LICENSE

This subsection describes the licensing process Radiant is anticipating to pursue if utilizing a manufacturing license for the manufacture of the Kaleidos reactor and its balance of plant. Various sections of Part 52 Subpart F refer back to sections of Part 50. Refereced sections of Part 50 may be applicable as general information, or very obviously not applicable to the Kaleidos design (e.g., applicable only to a light water reactor), and are not included in this portion of the gap analysis.

6.1 General Provisions

Part 52 COL		Compliance Type	Compliance Rationale
52.0	Scope; applicability of 10 CFR Chapter 1 provisions	General Information	
52.1	Definitions	General Information	
52.2	Interpretations	General Information	
52.3	Written communications	General Information	
52.4	Deliberate misconduct	General Information	
52.5	Employee protections	General Information	
52.6	Completeness and accuracy of information	General Information	
52.7	Specific exemptions	General Information	
52.8	Combining licenses; elimination of repetition	General Information	
52.9	Jurisdictional limits	General Information	
52.10	Attacks and destructive acts	General Information	
52.11	Information collection requirements; OMB approval	General Information	

6.2 Subpart F, Manufacturing License

Part 52 COL		Compliance Type	Compliance Rationale
52.151	Scope of subpart	General Information	
52.153	Relationship to other subparts	General Information	

Part 52 COL		Compliance Type	Compliance Rationale
52.155	Filing of applications	General Information	
52.156	Contents of applications; general information	Action Required	Referenced 50.33(a) through (d), and (j).
52.157	Contents of applications; technical information in final safety analysis report		
(a)	Principal Design Criteria	Action Required	NOTE: RG 1.232 has been used to inform the principal design criteria for the Kaleidos reactor. Appendix A is utilized for reference only.
(b)	Design Bases	Action Required	
(c)	Description and Analysis of SSCs	Action Required	
(d)	Engineered safety features	Action Required	
(e)	Radioactive materials produced during operation	Action Required	
(f)	Compliance with technical requirements of 10 CFR 1, to include:		
(1)	Analysis and evaluation of SSCs	Action Required	
(2)	Fire protection system	Action Required	
(3)	Thermal shock events	Not Applicable	Pressurized thermal shock events are applicable to systems that contain water; the Kaleidos design does not utilize water in any capacity. This section has been deemed not applicable to the Kaleidos design.
(4)	Combustible gas controls	Action Required	Referenced to 50.44 (refer to section 4 for any amplifying notes).
(5)	Coping analysis	Not Applicable	Applicable to light water reactors only, per 10 CFR 50.63.
(6)	Electrical equipment important to safety	Action Required	Referenced to 50.49.
(7)	Risk reduction for ATWS	Not Applicable	Applicable to light water reactors only.
(8)	Criticality accident compliance	Potential Exemption	Referenced to 50.68.
(9)	Minimizing contamination	Action Required	
(10)	Reserved	Not Applicable	Reserved

Part 52 COL		Compliance Type	Compliance Rationale
(11)	Control of radioactive gaseous and liquid effluents	Not Applicable	Referenced to 50.34a(e) (refer to section 4 for any amplifying notes).
(12)	Three Mile Island requirements	Not Applicable	Applicable to light water reactors only.
(13)	Risk informed SSCs	Action Required	Referenced to 50.69 (refer to section 4 for any amplifying notes).
(14)	Earthquake engineering criteria compliance for reactor	Action Required	
(15)	Compliance with requirements for testing, analysis, and prototypes	Action Required	Referenced to 50.43.
(16)	Technical qualifications of applicant	Action Required	
(17)	Quality assurance program	Action Required	
(18)	Technical Specifications applicable to the manufactured reactor	Action Required	Referenced to 50.36 and 50.36a.
(19)	Site parameters utilized for reactor design	Action Required	
(20)	Reactor interface requirements	Action Required	
(21)	Compliance of interface requirements via inspection, testing, or analysis	Action Required	
(22)	Conceptual design of nuclear power facility	Action Required	
(23)	For LWR's, a description of design features for severe accidents	Not Applicable	Applicable to light water reactors only.
(24)	Reserved	Not Applicable	
(25)	For modular designs, description of possible operating configurations	Not Applicable	
(26)	Management plan for design and manufacturing	Action Required	
(27)	Preoperational testing and initial operation	Action Required	
(28)	Unresolved Safety Issues identified in NUREG-0933	Action Required	NOTE: Additional Evaluation required for NUREG-0933 requirements.
(29)	Operating experience	Action Required	
(30)	LWR evaluation of design against SRP	Not Applicable	Applicable to light water reactors only.

Part 52 COL		Compliance Type	Compliance Rationale
(31)	Description of PRA and results	Action Required	
(32)	Aircraft assessment	Potential Exemption	Referenced to 50.150 (refer to section 4 for any amplifying notes).
52.158	Contents of application; additional technical information	Action Required	
52.159	Standards for review of application	General Information	
52.161	Reserved	Not Applicable	
52.163	Administrative review of applications; hearings	General Information	
52.165	Referral to the Advisory Committee on Reactor Safeguards (ACRS)	General Information	
52.167	Issuance of manufacturing license	General Information	
52.169	Reserved	Not Applicable	
52.171	Finality of manufacturing licenses; information requests	General Information	
52.173	Duration of manufacturing license	General Information	
52.175	Transfer of manufacturing license	General Information	
52.177	Application for renewal	General Information	
52.179	Criteria for renewal	General Information	
52.181	Duration of renewal	General Information	