Assessing Licensing Management Maturity in Nuclear Power Plant Projects

A Preliminary Study of the Licensing Management Maturity Model (LMMM)

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2026 KNS Autumn Meeting, Gyeongju, Korea

Licensing delay is a recurring cause of Nuclear Projects overrun

SCALE

60+

reactors under construction in East Asia, the Middle East, Europe and South and Southeast Asia, early 2025

SCHEDULE

2009 → 2023

Olkiluoto-3: planned target versus regular electricity production; cost reported near 3× the original estimate

COST

~GBP 46bn

Hinkley Point C, re-estimated by EDF in 2024, against about GBP 18bn approved in 2016

The OECD NEA and the World Nuclear Industry Status Report both place **licensing delay among the leading schedule risks.**

Licensing is how the state controls nuclear risk, so **weak coordination delays construction, forces late re-engineering, and erodes public confidence.**

Regulatory stringency and the quality of licensing management are different things.

No validated instrument assesses how well a developer manages licensing



Developers

No structured way to benchmark their own licensing readiness before problems surface mid-project.



Newcomer regulators

No benchmark for judging readiness to carry a project through the full licensing cycle.



Researchers

No repeatable, evidence-based method for comparing licensing experience across countries.



International bodies

Cannot target technical assistance without a shared diagnostic language.

Research questions

PRIMARY QUESTION

How can licensing management maturity be assessed across NPP projects in different regulatory environments, on observable and verifiable evidence, and how far can this be done with public sources alone?

SRQ1

Dimensions & indicators

What are the key dimensions and maturity indicators of effective licensing management?

SRQ2

Established vs. newcomer

How do practices differ between established and newcomer regulatory frameworks, and what do public sources leave undetermined?

SRQ3

Practices behind maturity

Which observable practices accompany higher levels, and which weaknesses recur?

SRQ4

Transferability

Which practices are general enough to be adopted elsewhere, and what conditions would adoption depend on?

Design: Build the model first, Test its wording, then Apply it

1. Model construction

Design-science procedure. 18 indicators, each traced to a documented driver of licensing delay.

2a. Informed-panel review

54 respondents rated descriptor clarity on six calibration vignettes and rated indicator relevance. Tests wording, not validity.

2b. Comparative case study

Four developers (KHNP, ENEC, TVO, NNB/EDF). Public sources only, two-source rule, assessed-entity rule, lower-bound scoring.

Wording fixed before any case is scored

The LMMM: five maturity levels, six domains, eighteen indicators, ninety descriptors

5	**Optimizing** Measurement drives deliberate change
4	**Quantitatively managed** Process is measured and reported
3	**Defined** Documented procedure applied across the organisation
2	**Managed** Consistent but reactive
1	**Initial** Ad hoc, depends on individuals

RIM
Regulatory Interface Mgmt

DKM
Documentation & Knowledge

SPE
Stakeholder & Public Eng.

SRM
Schedule & Risk Mgmt

OCG
Organisational Capacity & Gov.

ALCI
Adaptive Learning & CI

Each domain holds 3 indicators × 5 levels = 15 descriptors

Descriptors are written to be observed, not judged

Observable
Confirmable from a document or record

Distinguishable
Adjacent levels differ on one stated dimension

Single condition
No bundled elements to half-satisfy

Cumulative
Highest level the evidence supports is assigned

EXAMPLE

SRM-5: licensing obligations flowed down to contractors

5	Measurement reshapes contracting and oversight
4	Contractor conformance is measured
3	**Obligations in contracts, verified during work**
2	General compliance clauses; verification is reactive
1	No obligations in contracts; checked only on submission

Informed-panel review: the wording is clear enough to test, but not yet reliable

54
respondents; 45% response rate

59%
nuclear-sector experience; 4 in licensing

6 / 6
vignettes read at the intended level

α = 0.287
chance-corrected agreement (v1.0): low

Weakest point the level 2–3 documentation boundary: 19–29% read one level away

Revised after the panel 2 descriptors, 2 definitions, 1 convention; v1.1 not re-tested

Not a validation relevance ratings are indicative; content validity is future work

Four contrasting cases, scored only from public evidence

Shin-Hanul 3 & 4

KHNP (Korea)

REGULATOR

Established regulator: NSSC

STAGE ASSESSED

Permit application and review

Barakah

ENEC / Nawah (UAE)

REGULATOR

Newcomer regulator: FANR

STAGE ASSESSED

Construction and operation

Olkiluoto-3

TVO (Finland)

REGULATOR

Demanding regulator: STUK

STAGE ASSESSED

Build and commissioning

Hinkley Point C

NNB GenCo / EDF (UK)

REGULATOR

ONR: site licence, consents

STAGE ASSESSED

Construction

SCORING RULES

Two-source rule

A cell is scored only with two independent sources

Assessed-entity rule

Only evidence about the developer, never the regulator

Lower-bound rule

Score the lowest level the evidence bears, or record ND

Results: 32 of 72 cells scored, none above level 3

72
18 indicators × 4 cases

32
cells scored (44%)

40
Not Determinable (56%)

0
cells at level 4 or 5

Scored cells per case, of 18



Most scored cells sit at level 2
20 at level 2, 8 at level 3, 4 at level 1

NNB/EDF has the most evidence
7 level-3 cells, the highest in the study

Spread of 13 vs 5 cells
came from obtaining documents that existed throughout

Cross-case: 8 of 18 indicators are comparable

Indicator	KHNP	ENEC	TVO	NNB/EDF
SRM-5 Flow-down to contractors	L2	L2	L2	L2
OCG-1 Defined licensing organisation	L2	L2	L2	**L3**
OCG-2 Competence framework	L2	L2	L2	**L3**
ALCI-5 Handling of lessons learned	L2	L2	L1	L2
RIM-5 Design-change screening	L2	**L3**	*ND*	**L3**
RIM-1 Engagement planning	L2	*ND*	*ND*	**L3**
OCG-3 Hold-point approval	*ND*	*ND*	L1	**L3**
ALCI-1 Lessons capture and recurrence	*ND*	*ND*	L1	**L3**

Levels are never averaged within domains.

CASES SCORED PER INDICATOR

4	**SRM-5, OCG-1, OCG-2, ALCI-5**
3	**RIM-5**
2	**RIM-1, OCG-3, ALCI-1**
0–1	10 indicators: no cross-case statement

Propositions for testing, and limits

PROPOSITIONS

Not findings, to be tested

P1	Regulatory publication practice shapes the visible profile
P2	Contractor flow-down is weak in all four cases
P3	A defined licensing organisation with independent challenge goes with higher levels nearby; design novelty is a rival explanation
Open	Dates announced without an estimating basis cannot be tested: SRM-2 is ND everywhere

LIMITS

What the study does not claim

1	That any developer manages licensing better than another
2	A link from maturity to schedule or cost; that needs outcome data and a larger sample
3	Construct or predictive validity; content validity awaits a practitioner panel
4	Anything about levels 4 and 5 from public evidence

Prospective application: Vietnam

A prospective application, not a fifth case

Each developer assessed separately; most cells would be ND today

EVN Ninh Thuan 1

PVN Ninh Thuan 2

FOUR INDICATORS IN FOCUS

OCG-1 Defined licensing organisation with documented authority; it separated NNB from TVO

RIM-1 Documented pre-application engagement plan with the regulator, VARANS

SRM-5 Licensing obligations flowed down to vendor and suppliers; weak in all four cases

SRM-2 Estimating basis, with contingency, for every licensing date announced

Contributions and next steps

Model	Nuclear-specific maturity model for licensing management; every indicator traced to a documented delay driver
Method	Wording tested by a panel before scoring; rules keep claims within public evidence
Application	Four case profiles: what public sources can and cannot establish
Next	Validate with licensing professionals, gather developer data, test propositions against outcomes

Thank you. Questions welcome.