

# Feasibility Study of Visual and Measurement Technology for Innovative Approach <Q.I Incorporated>

**Purpose and Goal**

①Purpose: Study the feasibility of realization of radiation tolerant TV camera system required for Innovative Approach.  
 ②Goal: Cumulative dose 2MGy, Dose rate 10kGy/h in radiation resistance. 100mm(dia.) x 600mm(L)/4kg in camera head dimensions/weight and study the feasibility of realization of down sizing.

**Outcome obtained**

<Results of 1<sup>st</sup> irradiation test>

- Schedule: 1/29, 2015 – 2/6, 2015.
- Irradiation source: gamma ray (Co60).
- Test target: components of TV camera system.
- Irradiation condition: Power-off condition, Dose rate 10KGY/h, accumulated dose 2MGy.

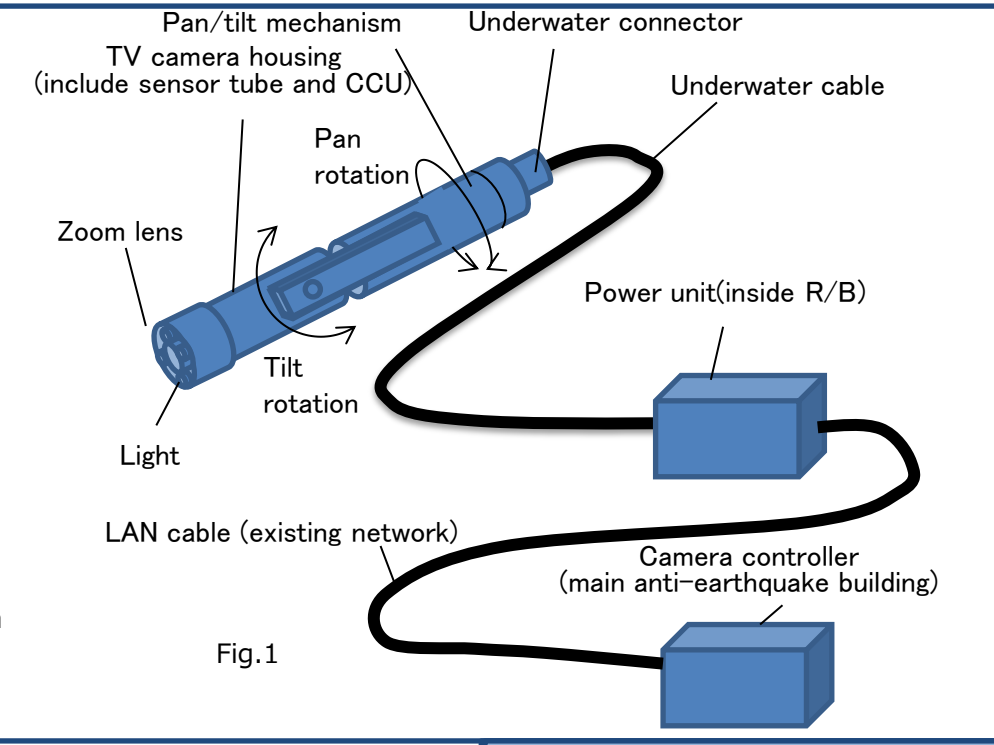
<2<sup>nd</sup> irradiation test schedule>

- Schedule: 3/18, 2015 – 3/28, 2015.
- Irradiation source: gamma ray (Co60)
- Test target: Estimation prototype of TV camera system (camera head, fixed focus lens (attached to TV camera), LED light, pan/tilt mechanism)
- Irradiation condition: Power-on condition, Dose rate 12.9KGY/h, Accumulated dose 2MGy.

**Overview and Feature**

We study the feasibility of realization of function/performance required for TV camera system in following subjects. (Fig.1)

- Radiation resistance of TV camera.
- Radiation resistant lens.
- Lighting function and its radiation resistance.
- Pan/Tilt function and its radiation resistance.
- Development of radiation resistant TV camera system based on above components/functions.
- Q.I have a lot of technologies and records on radiation resistant TV camera.
- We studied the feasibility of whole TV camera system based on above.
- Regarding the lens, we studied the feasibility of small-size radiation resistant zoom lens for camera head down-sizing.



Components	Results of 1 <sup>st</sup> irradiation test	Results of 2 <sup>nd</sup> irradiation test	Radiation resistance evaluation
Camera head	• Electrical parameters of peculiar IC and transistor was deteriorated.	• Refer to [Whole system]	• Video signal output function was maintained with 2MGy irradiated video process IC in 1 <sup>st</sup> irradiation test. (but lower signal level.) • Refer to [Whole system] for evaluation in 2 <sup>nd</sup> irradiation test.
Lens	• Lens adhesion bond was tested. • Slightly hardened and colored, but usable.	• Refer to [Whole system]	• Lens adhesion bond evaluated in 1st irradiation test can be used for zoom lens in R&D phase. • Refer to [Whole system] for evaluation in 2 <sup>nd</sup> irradiation test.
Cable	• Inclusion was deteriorated.	• Not a target in 2 <sup>nd</sup> irradiation test.	• Alternatives to deteriorated materials are to be studied in R&D phase.
Light	• Lighting function was maintained.	• Refer to [Whole system]	• Confirmed that luminance decreased slightly but lighting function was maintained in 1 <sup>st</sup> irradiation test. • Refer to [Whole system] for evaluation in 2 <sup>nd</sup> irradiation test.
Pan/tilt mechanism	• Both motor and encoders malfunctioned.	• Refer to [Whole system]	• Alternatives to malfunctioned motor and encoders in 1 <sup>st</sup> irradiation test are to be studied in R&D phase. • Refer to [Whole system] for evaluation in 2 <sup>nd</sup> irradiation test.
Whole system	• Not tested in 1 <sup>st</sup> irradiation test.	• TV camera malfunctioned during irradiation. Under irradiation, the video image was became slightly white by radiation noise, but no significant degradation. • Lens transmittance decreased, but enough total transmittance was maintained. • LED and pan/tilt mechanism maintained operation up to 2MGy under power on condition.	• TV camera malfunctioned during irradiation, resulted from IC degradation. • Radiation resistance of fixed focus lens is enough in practical use. For zoom lens, evaluation of transmittance is important because of increase of component lens numbers. • LED light maintained luminance up to 2MGy under power on condition. • Components passed 1 <sup>st</sup> irradiation test were used for Pan/tilt mechanism test.

**Challenges and Issues in the future**

- TV camera design with electronic components which have continuity of availability.
- Circuit design with compensation for parameter deterioration by irradiation and improvement of peculiar IC in radiation resistance.
- Development of radiation resistant small-size zoom lens prototype.
- Investigation and estimation of alternatives to deteriorated cable materials.
- Development of small-size built-in light prototype using LED.
- Investigation and estimation of alternatives to deteriorated motor and encoders.
- Development and study of practical applicability of TV camera system that satisfies target spec, based on 2<sup>nd</sup> irradiation test.