PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS FOR RADIOACTIVITY

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Proposed Relaxation of EPA Drinking Water Standards for Radioactivity

The U.S. Environmental Protection Agency has drafted extraordinary new radiological standards for responding to radiological releases from a wide range of events. A copy of the secret draft "Protective Action Guidance for Radiological Incidents," dated August 2007 and marked "Please Do Not Distribute" and "Do Note Cite or Quote," was obtained and made public by Doug Guarino of the trade publication *Inside EPA*, who has written about the concerns the document has triggered within EPA and among state regulators.[1] We understand EPA is contemplating soon issuing the draft.[2] Here we analyze one of the most controversial aspects of the document, its proposal to allow the public to ingest drinking water with radioactive concentrations orders of magnitude higher than EPA's longstanding radiological drinking water standards permit.

Background

In the early 1990s, EPA issued its "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents."[3] Protective Action Guides, or PAGs, are radiation levels that when exceeded trigger protective actions. For example, if a nuclear incident would in contamination of soil at levels above the PAGs, people may be evacuated so as to keep their radiation dose below the specified amount.

The PAGs applied to a range of nuclear incidents "at a variety of facilities, including, but not limited to, those that are part of the nuclear fuel cycle, defense and research facilities, and facilities that produce or use radioisotopes, or from the transportation or use of radioactive materials at locations not classified as 'facilities.'" The original PAG guidance and the current proposed revision thereto divide the responses to a nuclear incident into: the early phase, the intermediate phase, and long-term cleanup activities. The early phase last hours to days, the intermediate phase months to years, and the long-term cleanup phase potentially many years.

The new draft PAGs EPA is reported to be contemplating soon releasing revise the existing PAGs in numerous ways that have triggered great controversy. Despite the fact that radiation is now officially deemed to be more dangerous than previously thought, virtually all of the changes to the PAGs have been in the direction of permitting higher exposures to the public.[4]

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[1] The EPA document is available at http://www.committeetobridgethegap.org/pdf/pag102108.pdf
[2] Although no substantive revisions to the August 2007 draft have been reported, it is possible that there may have been some. The analysis here is based on the August 2007 draft.
[3] Issued by the EPA Office of Radiation Programs, Revised 1991, second printing 1992. Posted at http://www.epa.gov/radiation/docs/er/400-r-92-001.pdf We will here refer to the existing PAGs as the 1992 PAGs.
[4] EPA and other agencies requested and funded the National Academy of Sciences to prepare updated cancer risk estimates for ionizing radiation based on the most current research. The report, *Health Risks from Exposure to Low Levels of Ionizing Radiation*, National Academy Press, 2006, estimated cancer risk at 1.14 cancers per 1000 person-rem, considerably higher than

For example, permitted exposures for the majority of radionuclides in the early phase have increased. For 33 radionuclides, the permissible concentrations to which the public may be exposed without protective actions being taken in the early phase have been increased, while for only 19 have they been tightened.[5] Furthermore, those that have had their limits relaxed have done so by an average of 76%, whereas the radionuclides that have more limiting concentrations have been tightened by only 34%.

Long-term cleanup is now proposed to use a much opposed process called "optimization" that would allow the choice of radiation "benchmarks" as immensely high as 10 rem per year, the equivalent of about 50,000 chest X-rays over a 30 year period and an associated cancer risk of 1 in 3, according to current risk estimates prepared for EPA and other agencies.[6] EPA historically has insisted on an "acceptable" risk range of one in a million to one in ten thousand, so contemplating "benchmarks" with a risk as high as every third person so exposed getting a cancer from the exposure would be a radical departure from its entire history and ethically very difficult to defend.[7]

These are deeply troubling proposed relaxations of longstanding EPA radiation protections, for the early and late phase responses to a radiological releases. Without diminishing our concern about those phases, we here focus on the intermediate phase PAGs, and particularly those related to drinking water.

The Intermediate Phase PAGs

Under EPA's longstanding PAGs for the intermediate phase, total dose to the public without protective action is limited to 2 rem for the first year and 0.5 rem (500 millirem) per year for subsequent years. The 1992 PAGs provide guidance in determining when those limits would be exceeded. Part of that guidance were Protective Action Guides for the Intermediate Phase for Food and Water (chapter 3 of the 1992 PAGs). The food PAGs were prepared by the Food and

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past estimates used by EPA and other agencies, including the figures used by EPA in creating the 1992 PAGs.

[5] See Table 2-5 of the new PAGs (pp. 2-22 to 2-26) which compares, radionuclide by radionuclide, the revised early phase PAGs with the 1992 ones.

[6] For a discussion of the problems of "optimization" and the employment of "benchmarks" in long-term cleanup decisions, and the cancer risks associated with the radiation levels contemplated, see the correspondence by dozens of organizations and individuals criticizing new PAGs issued by the Department of Homeland Security for responding to "dirty bomb" attacks. http://www.committeetobridgethegap.org/pdf/2006Ltr102108.pdf and http://www.committeetobridgethegap.org/pdf/sfundgroup102108.pdf The controversial DHS guidance for dirty bombs is now being proposed by EPA to be expanded to cover a wide range of non-terrorist events involving radiological releases.

[7] Note that when we speak of cancer risks from exposure to radiation, these risks are *in addition* to one's normal risk of getting cancer; i.e., these are *excess* cancers, ones that would not have appeared had it not been for the radiation exposure.

Drug Administration and included by EPA in the 1992 guidance. They specified that no more than 0.5 rem per year should come from the ingestion pathway and calculated radioactive concentrations to meet that limit. Importantly, the existing food PAGs include drinking water. Also importantly, they were not additive on top of the overall dose limits, but a component of them.

EPA is now proposing to turn its past guidance on its head. It now proposes to permit one to *add* the 500 millirem food PAG to the overall dose limit. And it now proposes – even though the food PAG already contains a water ingestion component – to create an entirely new Drinking Water PAG, which would be added onto the general intermediate PAG *and* the food PAG. In other words, if the existing overall intermediate dose limit is 2 rem for the first year and 0.5 rem for subsequent years, the proposed PAG would be for the first year 2 + 0.5 + 0.5 rem, or 3 rem; and for subsequent years 0.5 + 0.5 + 0.5 rem, or 1.5 rem – a tripling of permissible dose.

EPA would not just be double- or triple-counting, it would be doing so twice. Since drinking water is already included in the 0.5 rem food ingestion PAG, creating a separate water PAG that can be added to the food PAG counts the water radiation twice. And then permitting the already duplicative food and water PAGs to the existing overall PAG radiation limit only compounds the injury to public health.

Astronomically High Levels of Radioactivity in Drinking Water Proposed

<u>Most troubling, however, are the absolutely astronomical values for radionuclides put forward in the new Drinking Water PAGs, levels that are hundreds, thousands, and even millions of times higher than EPA's current drinking water standards for radiation.</u>

For decades EPA has set permissible concentrations of radionuclides in drinking water. These limiting levels, called Maximum Concentration Levels (MCLs), are established via the Safe Drinking Water Act. Under certain emergency situations, levels higher than MCLs can be used in determining when to take an urgent response (e.g., providing replacement water supplies such as bottled water or requiring treatment of the water). Those longstanding EPA emergency limits are called Removal Action Levels (RALs).

In the new draft PAGs, EPA proposes taking no response to protect people from radioactivity in drinking water until concentrations rise to levels that are so high as to be frankly beyond comprehension. It is difficult to believe any responsible EPA official would sign off on radioactivity concentrations in drinking water that high. Yet, buried deep in the new PAGs is a table – Table 4.1 – that puts forward radioactivity levels for drinking water so immense as make it difficult to imagine what those responsible for the table could possibly have been thinking. No comparison to existing EPA drinking water standards is provided in the new PAG document, so it is likely responsible decision-makers who are asked to sign off on these revisions would have no inkling of the significance, of how much a departure this is from EPA's historical practices of protecting members of the public from excessive radioactivity in their drinking water.

We here have performed the missing analysis, comparing the new proposed drinking water radioactivity levels with EPA's current drinking water requirements, radionuclide by radionuclide. We can only hope that responsible officials within EPA and the Administration more generally will, upon seeing the extraordinary magnitude of the dramatic change from longstanding protective requirements proposed, not wish to carry the ethical stain of having approved exposing the American public to radioactivity levels in their drinking water that would shock the conscience.

The New Radioactivity Drinking Water PAGs

The draft PAG document calls the new drinking water limits Derived Response Levels, or DRLs. The DRLs simply are the level of radioactivity in drinking water that EPA would allow people to be exposed to without EPA taking a protective action like providing alternative clean drinking water supplies. Like the existing EPA drinking water standards of MCLs and RALs discussed above, the DRLs are measured in units of pico-Curies of radioactivity per Liter of water – pCi/L.

Without discussion as to when one should use one or the other, two sets of DRLs are set forth in the new PAGs – Derived Response Levels with and without decay. The DRLs with decay apparently presume that the levels detected in drinking water will promptly decay based on the half-life of the radionuclide, and therefore permit higher concentrations –and in some cases, very much higher concentrations – than in the case where they don't presume decay.

The assumption that you can permit people to be exposed to very high concentrations of radioactivity in their drinking water because it will subsequently decay to lower levels is questionable and contrary to most EPA practice. There are other factors besides radioactive decay that affect concentrations in water. One frequently sees concentrations *increase*, as more radioactivity from the contamination source moves into the groundwater. Increasing concentrations wouldn't be possible if the only factor involved were radioactive decay. Additionally, some radionuclides decay into other radionuclides ("daughter products"), so rather than the level of daughter products declining by decay, they actually increase in concentration. EPA practice has historically been to take action when concentrations exceed permissible limits and then stop those actions if and when the concentrations decline below those limits, not allow exceedances based on the hope that sometime thereafter they will through decay or other means go back down.

So there are two sets of proposed drinking water limits in the PAGs –DRLs with and without decay.[8] We here compare both to the longstanding EPA drinking water standards for radioactivity, the MCLs and the RALs. The MCL is EPA's primary drinking water standard under the Safe Drinking Water Limit. Under CERCLA, EPA has also established emergency response levels, the Removal Action Levels. (These aren't long-term cleanup standards, which

[8] One finds the DRLs with an without Decay in the last two columns of Table 4-1 in the new PAGs.

use the MCLs, but time-urgent response standards that determine when actions like providing alternative water supplies are immediately needed.)

The RALs are based on the MCL or the concentration of radioactivity in drinking water that would produce a 10^{-4} (one in ten thousand) cancer risk, whichever is greater. The EPA method for deriving the 10^{-4} concentration is described in Table 6 of this report. Many EPA Regions simply use the MCLs for their emergency response levels for radioactivity rather than the RALs, and EPA has now, for chemicals, established new RALs which are the MCLs. So the primary comparison of the new proposed drinking water levels, DRLs, should be with the MCLs, but for completeness purposes, we have also compared them with the RALs.

The Magnitude of Increased Permissible Radiation Exposure Proposed

Table 1 of this report compares the new with the existing drinking water standards. For example, the DRL without decay for strontium-90 is 6,650 pCi/L without decay and 6730 with decay (not much different because of its long life), whereas the current EPA MCL is 8 and the RAL is 39. Thus EPA now proposes to permit people to be exposed at levels roughly a thousand times higher than its current Safe Drinking Water Act limit (the MCL), and 170 times higher than its emergency response level, the RAL. Iodine-131 has a DRL without decay of 8490 an with decay of 267,000; the MCL is 3, thousands to hundreds of thousands of times lower. Plutonium-239's DRLs are 732, versus an existing MCL and RAL of 15. Sm-151's DRLs are 1,890,000 pCi in the new PAGs, versus an existing MCL of 1000 (and RAL of 6250), about a factor of 2000-fold increase over Safe Drinking Water Levels. Nickel-63 has DRLs of 1,220,000 compared to an MCL of 50. And on and on, radionuclide by radionuclide, one sees massive relaxation of standards

Figures 2-5 and Tables 2-5 show the vastly increased concentrations of radioactivity that would be permitted under the new limits. For example, in Figure and Table 2, one sees that limits for all radionuclides are increased by at least roughly two orders of magnitude, with many increased by tens of thousands or even hundreds of thousands, with one increased by more than seven million-fold. In Figure and Table 3, comparing the new DRL without decay to the current MCL, the increases are all at least about two orders of magnitude, extending up to more than a million-fold increase. In Figure and Table 4, the DRL with decay ranges from about two orders of magnitude higher than the current RAL to about million times higher. And in Figure and Table 5, the DRL without decay is up to a hundred thousand times higher than the RAL. The radionuclide by radionuclide graphs that follow Table 5 show the astronomical increases in radioactivity concentrations in drinking water proposed compared to current limits.

Discussion

The proposal to permit radioactive concentrations hundreds, thousands, tens and hundreds of thousands, and even millions of times higher than current drinking water standards is simply breathtaking. One cannot conceive what the EPA staffers who put forward these new limits were thinking.

Providing replacement drinking water or requiring treatment of water supplies, when regular water supplies are contaminated, is a relatively simple matter done all the time by EPA. There simply is no reason to force people to drink highly contaminated water.

The EPA staffers who snuck these new limits into the PAG document may argue that it is not appropriate to compare these levels to EPA's Maximum Concentration Limits established under the Safe Drinking Water Act, as they are supposedly based on more routine exposures, and the DRLs are designed for nuclear incidents. However, the new PAGs define their scope as applicable to any radioactivity release, which is defined as any release that could require consideration of a protective action. They make clear they are for a wide range of releases, from a full nuclear power plant accident to fires at fuel cycle facilities to releases from radiopharmaceutical facilities to incidents involving transportation of radioactive materials.

Although there is a note in the PAGs saying they do not apply to site cleanups under Superfund or the NRC decommissioning program, or other federal or state cleanup programs (p. i), there is confusion as to how that assertion meshes with the statement of applicability of the PAGs referred to above that says they apply to all radioactive releases for which a response may be considered. Indeed, some within EPA have already pushed for abandoning EPA's CERCLA rules for Superfund cleanups and using instead the far more lenient PAGs. As Doug Guarino reported in *Inside EPA* on 24 October 2008, "EPA in a new draft guidance on how the agency's regional Superfund officials should justify emergency response actions at toxic waste sites suggests that for sites contaminated by radioactive substances, the officials should consult guidelines for catastrophic nuclear emergencies [the new EPA PAGs] that are significantly less stringent than traditional Superfund guidelines." There thus appears to be an effort to undermine the entire structure of EPA's radiation protection regime.

Additionally, EPA already has special standards for responding to radiological emergencies – the Superfund RALs, which provide guidance for when immediate response in an emergency situation is required. And the proposed DRLs are orders of magnitude less protective than the existing RALs.

EPA staff may also argue that because the exposure in the intermediate phase of a nuclear incident is expected to last only a year, they should be able to exposure people to a lifetime's worth of radiation in that one year. This is absurd. One isn't going to be able to guarantee that someone will have no additional radiation for the rest of their life, or hasn't already had prior exposures. And this is completely contradictory to longstanding EPA policy. EPA doesn't permit people to be exposed to higher than the MCL in any single year, irrespective of whether prior years have been lower or one can somehow hope that future years will be as well. Similarly, one doesn't permit exposures over the RAL in any one year by claiming future years may hopefully be brought under control. Furthermore, the PAGs make clear that the intermediate phase may continue for years.

Conclusion

In short, the draft EPA Protective Action Guidelines would increase by hundreds, thousands, and tens and hundreds of thousands of times or more the amount of radioactivity the public may be forced to consume in drinking water. It is irresponsible, and senior EPA and Administration officials should refuse to sign off on any such attempt.

TABLE 1

COMPARISON OF EPA's PROPOSED PROTECTIVE ACTION GUIDES [DERIVED RESPONSE LEVELS (DRLs)] FOR RADIOACTIVITY IN DRINKING WATER

vs.

EPA's LONGSTANDING

MAXIMUM CONCENTRATION LIMITS (MCLs)

and

REMOVAL ACTION LEVELS (RALs)

TABLE 1: COMPARISON OF PROPOSED PROTECTIVE ACTION GUIDE'S DERIVED RESPONSE LEVELS (DRLs) vs. CURRENT MAXIMUM CONCENTRATION LIMITS (MCLs) and REMOVAL ACTION LEVELS (RALs) for RADIOACTIVITY IN DRINKING WATER

Radionuclide	DRL w/o Decay*	DRL With Decay*	MCL*	RAL*
H-3	4,420,000	4,540,000	20,000	56,022
C-14	319,000	319,000	2,000	2,000
Na-22	58,000	66,100	400	400
P-32	77,100	1,370,000	30	315
S-35	239,000	731,000	500	5,960
Cl-36	199,000	199,000	700	891
Ca-45	260,000	513,000	10	1,116
Sc-46	125,000	397,000	100	513
V-48	93,400	1,460,000	90	417
Cr-51	4,790,000	43,700,000	6,000	18,405
Mn-54	257,000	374,000	300	1,345
Fe-55	557,000	631,000	2,000	2,924
Fe-59	103,000	591,000	200	389
Co-58	247,000	909,000	300	1,014
Co-60	53,900	57,600	100	192
Ni-63	1,220,000	1,220,000	50	4,902
Zn-65	46,900	75,400	300	300
Se-75	70,900	170,000	900	900
Rb-86	65,900	892,000	600	600
Sr-89	72,000	363,000	20	1,205
Sr-90	6,650	6,730	8	39
Y-90	68,800	6,530,000	60	196
Y-91	78,100	341,000	90	221
Zr-93	167,000	167,000	2,000	2,339
Zr-95	192,000	773,000	200	746
Nb-95	314,000	2,260,000	300	1,389
Mo-99	306,000	28,100,000	600	1,696
Tc-99	288,000	288,000	900	1,236
Ru-103	252,000	1,620,000	200	901
Ag-110m	66,500	106,000	90	315
Cd-109	92,600	120,000	600	612
In-114m	45,400	233,000	60	137
Sn-113	251,000	620,000	300	807
Sn-125	60,100	1,580,000	60	176
Sb-124	72,900	311,000	60	264
Te-127	1,100,000	712,000,000	900	3,435
Te-129	2,940,000	15,300,000,000	2,000	16,529

* units = picoCuries per Liter (pCi/L)

TABLE 1: COMPARISON OF PROPOSED PROTECTIVE ACTION GUIDE'S DERIVED RESPONSE LEVELS (DRLs) vs. CURRENT MAXIMUM CONCENTRATION LIMITS (MCLs) and REMOVAL ACTION LEVELS (RALs) for RADIOACTIVITY IN DRINKING WATER

Radionuclide	DRL w/o Decay*	DRL With Decay*	MCL*	RAL*
Te-129m	62,300	468,000	90	221
Te-132	48,600	3,780,000	90	90
I-132	48,600	3,780,000	90	90
I-129	1,750	1,750	1	24
I-131	8,490	267,000	3	77
Cs-136	60,100	1,160,000	800	800
Cs-137	13,600	13,800	200	200
Ba-140	71,200	1,410,000	90	230
La-140	91,600	13,800,000	60	318
Ce-141	260,000	2,030,000	300	763
Ce-143	165,000	30,400,000	100	495
Ce-144	35,300	5,330,000	30	30
Nd-147	171,000	3,940,000	200	473
Pm-149	186,000	21,300,000	100	532
Sm-151	1,890,000	1,890,000	1,000	6,250
Eu-152	135,000	139,000	200	1,087
Eu-154	90,700	94,300	60	309
Eu-155	566,000	607,000	600	1,835
Gd-153	665,000	1,070,000	600	2,290
Tb-160	115,000	415,000	100	400
Tm-170	140,000	320,000	100	395
Hf-181	165,000	984,000	200	550
Ta-182	120,000	297,000	100	437
W-187	294,000	74,700,000	200	948
Ir-192	135,000	477,000	100	472
Au-198	180,000	16,900,000	100	559
Hg-203	96,900	529,000	60	60
Tl-204	156,000	170,000	300	553
Bi-207	146,000	147,000	200	604
Np-237	1,730	1,730	15	32
Pu-239	732	732	15	15
Am-241	907	908	15	19
Cm-243	1,240	1,260	15	21

* units = picoCuries per Liter (pCi/L)

TABLES 2-5
FIGURES 2-5

SUMMARY COMPARISONS OF
EPA'S PROPOSED NEW PERMISSIBLE
CONCENTRATIONS OF RADIONUCLIDES
IN DRINKING WATER
[DERIVED RESPONSE LEVELS (DRLS)]

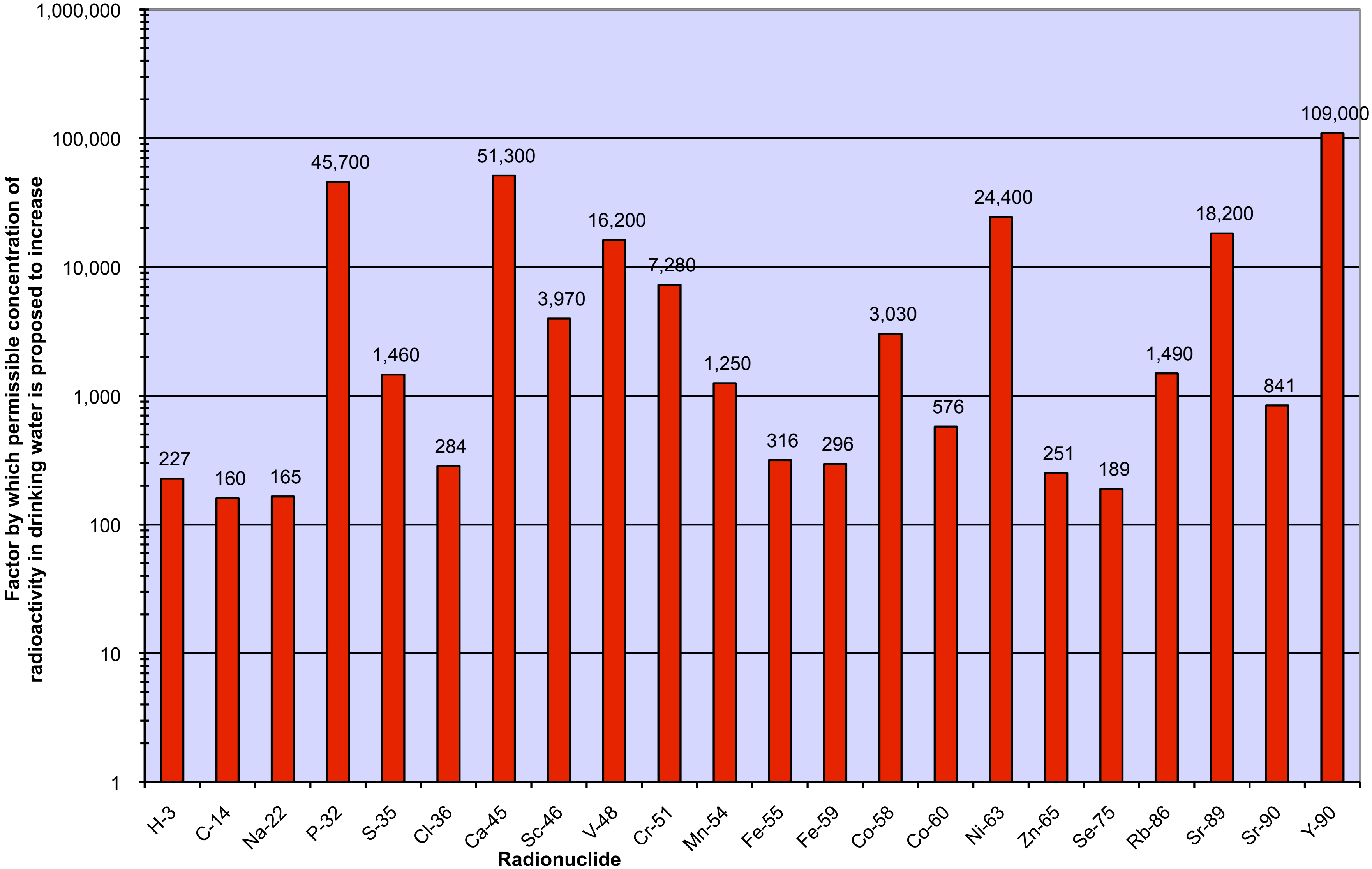
VS.

EPA'S LONGSTANDING RADIOACTIVITY
DRINKING WATER STANDARDS--
MAXIMUM CONCENTRATION LIMITS
(MCLS)
AND REMOVAL ACTION LEVELS (RALS)

NOTE: These comparisons focus on the beta particle- & photon-emitting radionuclides. Similar differences exist with the new limits for alpha-emitting radionuclides. For the convenience of the reader, the Figures are numbered to correspond to the associated Table; there is no Figure 1.

Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 2: Proposed DRL (with Decay) vs. Current Maximum Concentration Level (MCL)



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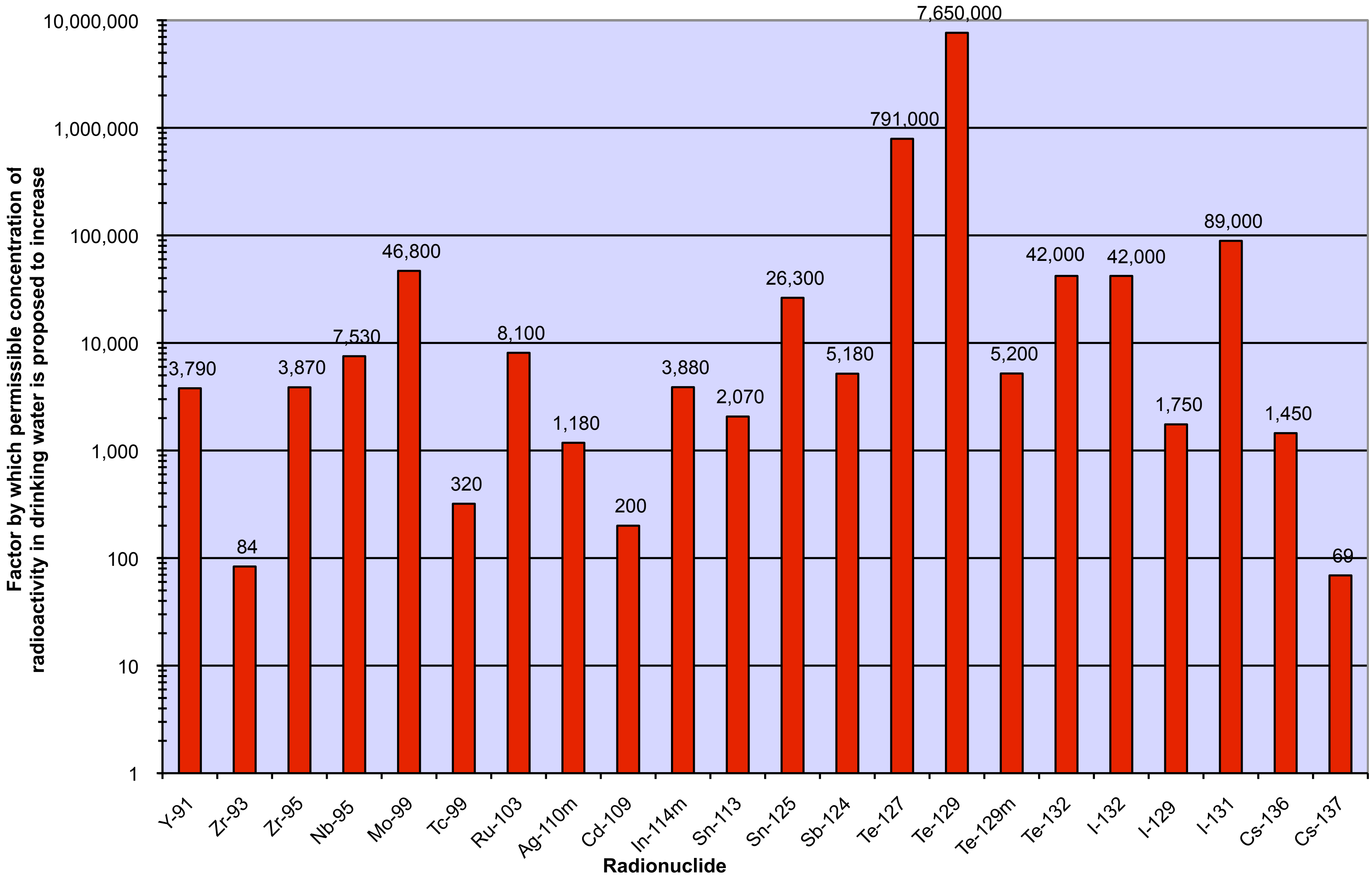

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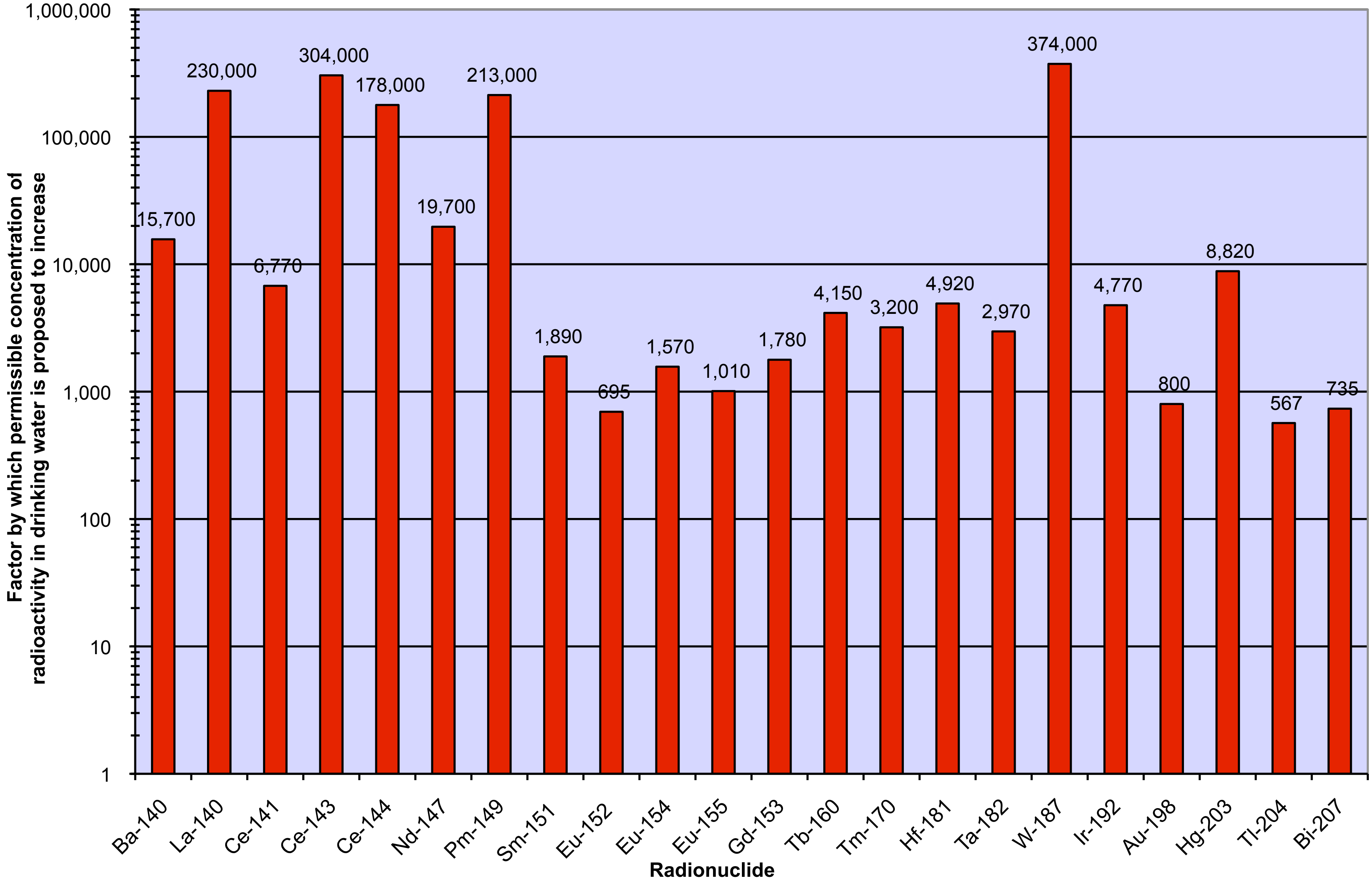


PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

TABLE 2: Proposed Derived Response Level [DRL] (with Decay) vs. Current Maximum Concentration Level (MCL)

Radionuclide	PROPOSED DRL w/ Decay*	CURRENT Maximum Concentration Level (MCL)*	RATIO (Factor by which permissible concentration of radioactivity in drinking water is proposed to increase)
H-3	4,540,000	20,000	**227**
C-14	319,000	2,000	**160**
Na-22	66,100	400	**165**
P-32	1,370,000	30	**45,700**
S-35	731,000	500	**1,460**
Cl-36	199,000	700	**284**
Ca-45	513,000	10	**51,300**
Sc-46	397,000	100	**3,970**
V-48	1,460,000	90	**16,200**
Cr-51	43,700,000	6,000	**7,280**
Mn-54	374,000	300	**1,250**
Fe-55	631,000	2,000	**316**
Fe-59	591,000	200	**296**
Co-58	909,000	300	**3,030**
Co-60	57,600	100	**576**
Ni-63	1,220,000	50	**24,400**
Zn-65	75,400	300	**251**
Se-75	170,000	900	**189**
Rb-86	892,000	600	**1,490**
Sr-89	363,000	20	**18,200**
Sr-90	6,730	8	**841**
Y-90	6,530,000	60	**109,000**
Y-91	341,000	90	**3,790**
Zr-93	167,000	2,000	**84**
Zr-95	773,000	200	**3,870**
Nb-95	2,260,000	300	**7,530**
Mo-99	28,100,000	600	**46,800**
Tc-99	288,000	900	**320**
Ru-103	1,620,000	200	**8,100**
Ag-110m	106,000	90	**1,180**
Cd-109	120,000	600	**200**
In-114m	233,000	60	**3,880**
Sn-113	620,000	300	**2,070**
Sn-125	1,580,000	60	**26,300**
Sb-124	311,000	60	**5,180**
Te-127	712,000,000	900	**791,000**

*Units = picoCuries per Liter (pCi/L)

PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

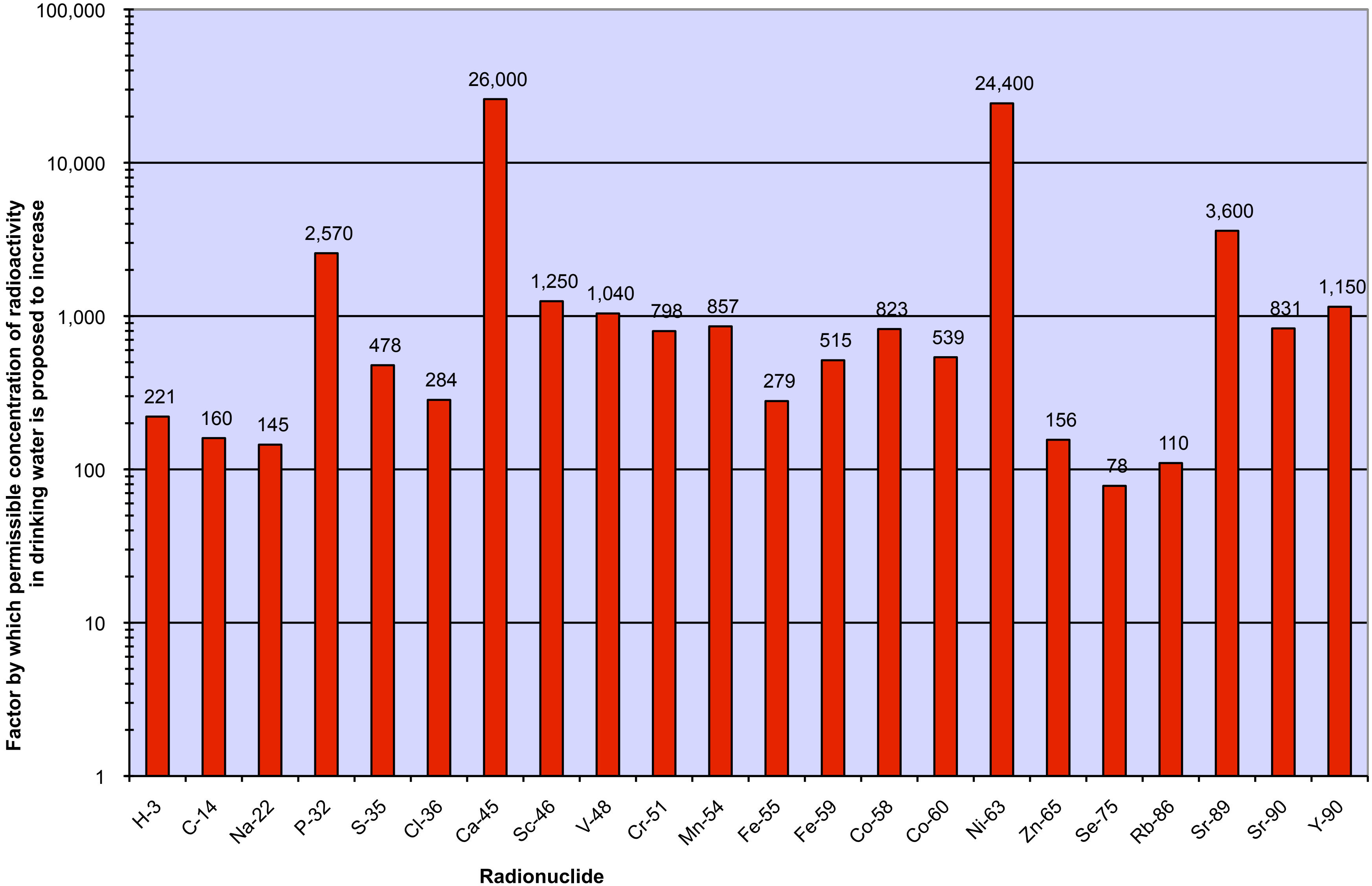
TABLE 2: Proposed Derived Response Level [DRL] (with Decay) vs. Current Maximum Concentration Level (MCL)

Radionuclide	PROPOSED DRL w/ Decay*	CURRENT Maximum Concentration Level (MCL)*	RATIO (Factor by which permissible concentration of radioactivity in drinking water is proposed to increase)
Te-129	15,300,000,000	2,000	**7,650,000**
Te-129m	468,000	90	**5,200**
Te-132	3,780,000	90	**42,000**
I-132	3,780,000	90	**42,000**
I-129	1,750	1	**1,750**
I-131	267,000	3	**89,000**
Cs-136	1,160,000	800	**1,450**
Cs-137	13,800	200	**69**
Ba-140	1,410,000	90	**15,700**
La-140	13,800,000	60	**230,000**
Ce-141	2,030,000	300	**6,770**
Ce-143	30,400,000	100	**304,000**
Ce-144	5,330,000	30	**178,000**
Nd-147	3,940,000	200	**19,700**
Pm-149	21,300,000	100	**213,000**
Sm-151	1,890,000	1,000	**1,890**
Eu-152	139,000	200	**695**
Eu-154	94,300	60	**1,570**
Eu-155	607,000	600	**1,010**
Gd-153	1,070,000	600	**1,780**
Tb-160	415,000	100	**4,150**
Tm-170	320,000	100	**3,200**
Hf-181	984,000	200	**4,920**
Ta-182	297,000	100	**2,970**
W-187	74,700,000	200	**374,000**
Ir-192	477,000	100	**4,770**
Au-198	80,000	100	**800**
Hg-203	529,000	60	**8,820**
Tl-204	170,000	300	**567**
Bi-207	147,000	200	**735**

*Units = picoCuries per Liter (pCi/L)

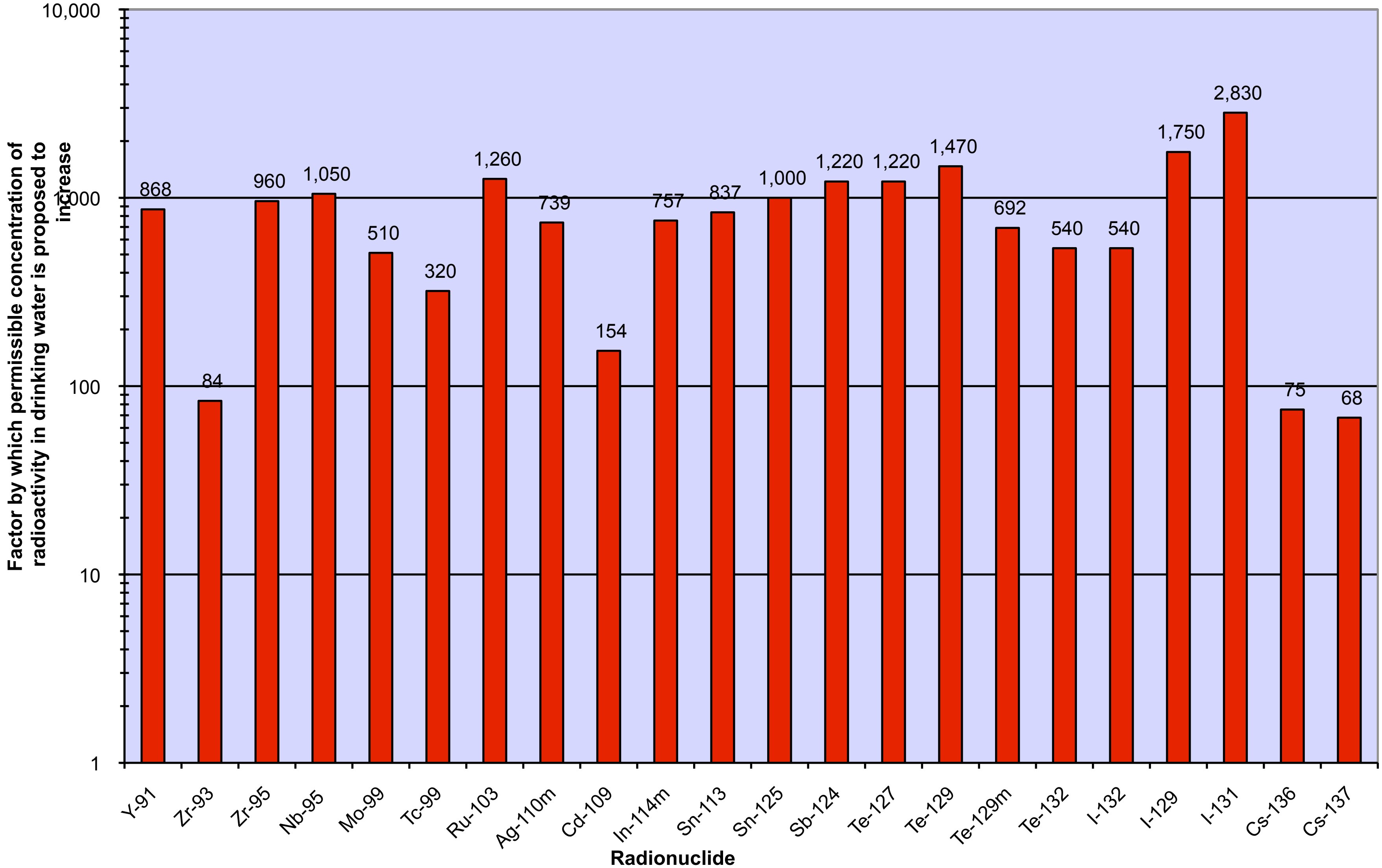
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 3: Proposed DRL (without Decay) vs. Current Maximum Concentration Level (MCL)



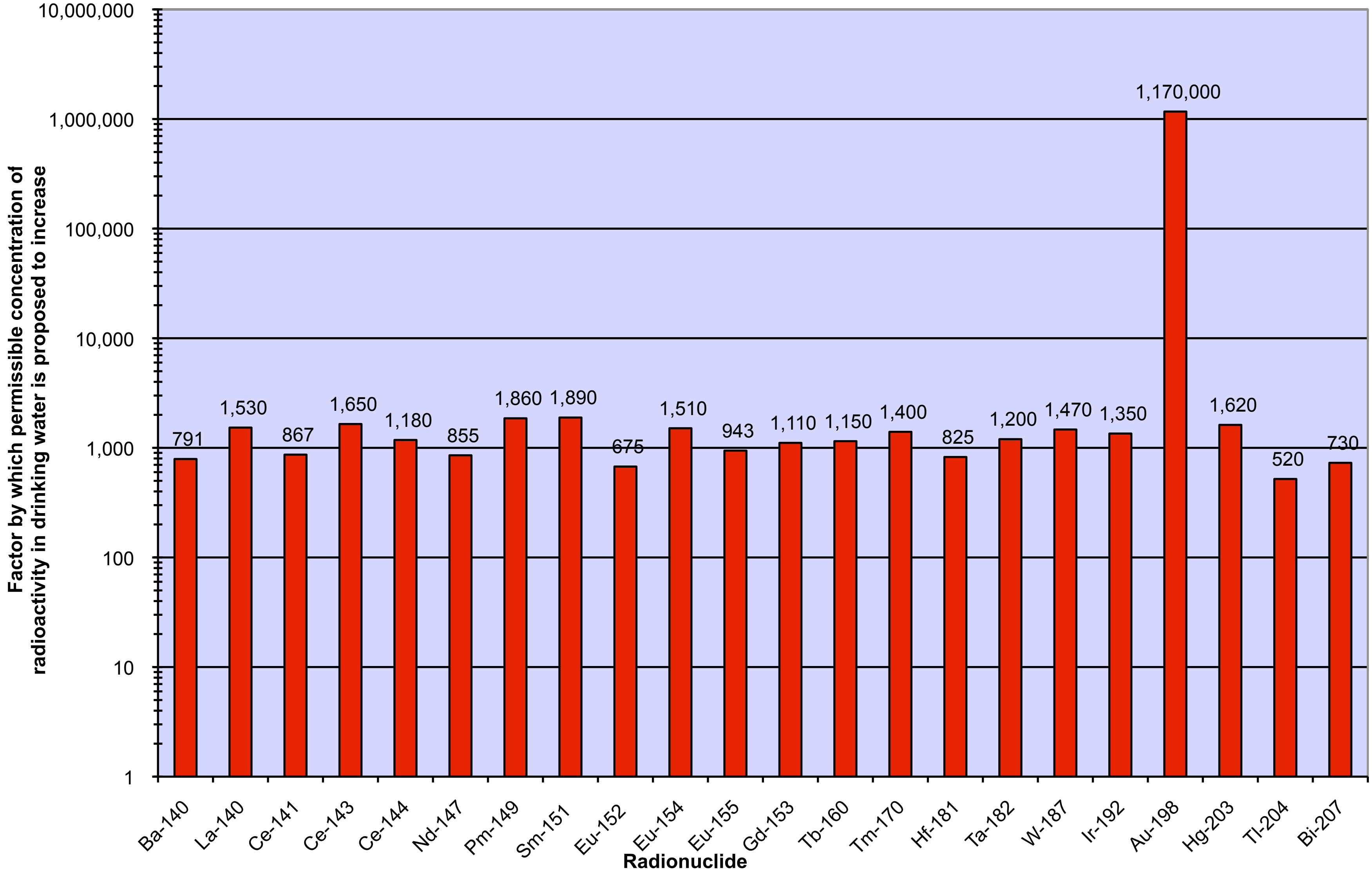
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 3: Proposed DRL (without Decay) vs. Current Maximum Concentration Level (MCL)



Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 3: Proposed DRL (without Decay) vs. Current Maximum Concentration Level (MCL)



PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

TABLE 3: Proposed Derived Response Level [DRL] (without Decay) vs. Current Maximum Concentration Level [MCL]

Radionuclide	PROPOSED DRL w/o Decay*	CURRENT Maximum Concentration Level (MCL)*	RATIO (Factor by which permissible concentration of radioactivity in drinking water is proposed to increase)
H-3	4,420,000	20,000	**221**
C-14	319,000	2,000	**160**
Na-22	58,000	400	**145**
P-32	77,100	30	**2,570**
S-35	239,000	500	**478**
Cl-36	199,000	700	**284**
Ca-45	260,000	10	**26,000**
Sc-46	125,000	100	**1,250**
V-48	93,400	90	**1,040**
Cr-51	4,790,000	6,000	**798**
Mn-54	257,000	300	**857**
Fe-55	557,000	2,000	**279**
Fe-59	103,000	200	**515**
Co-58	247,000	300	**823**
Co-60	53,900	100	**539**
Ni-63	1,220,000	50	**24,400**
Zn-65	46,900	300	**156**
Se-75	70,900	900	**78**
Rb-86	65,900	600	**110**
Sr-89	72,000	20	**3,600**
Sr-90	6,650	8	**831**
Y-90	68,800	60	**1,150**
Y-91	78,100	90	**868**
Zr-93	167,000	2,000	**84**
Zr-95	192,000	200	**960**
Nb-95	314,000	300	**1,050**
Mo-99	306,000	600	**510**
Tc-99	288,000	900	**320**
Ru-103	252,000	200	**1,260**
Ag-110m	66,500	90	**739**
Cd-109	92,600	600	**154**
In-114m	45,400	60	**757**
Sn-113	251,000	300	**837**
Sn-125	60,100	60	**1,000**
Sb-124	72,900	60	**1,220**
Te-127	1,100,000	900	**1,220**

*Units = picoCuries per Liter (pCi/L)

PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

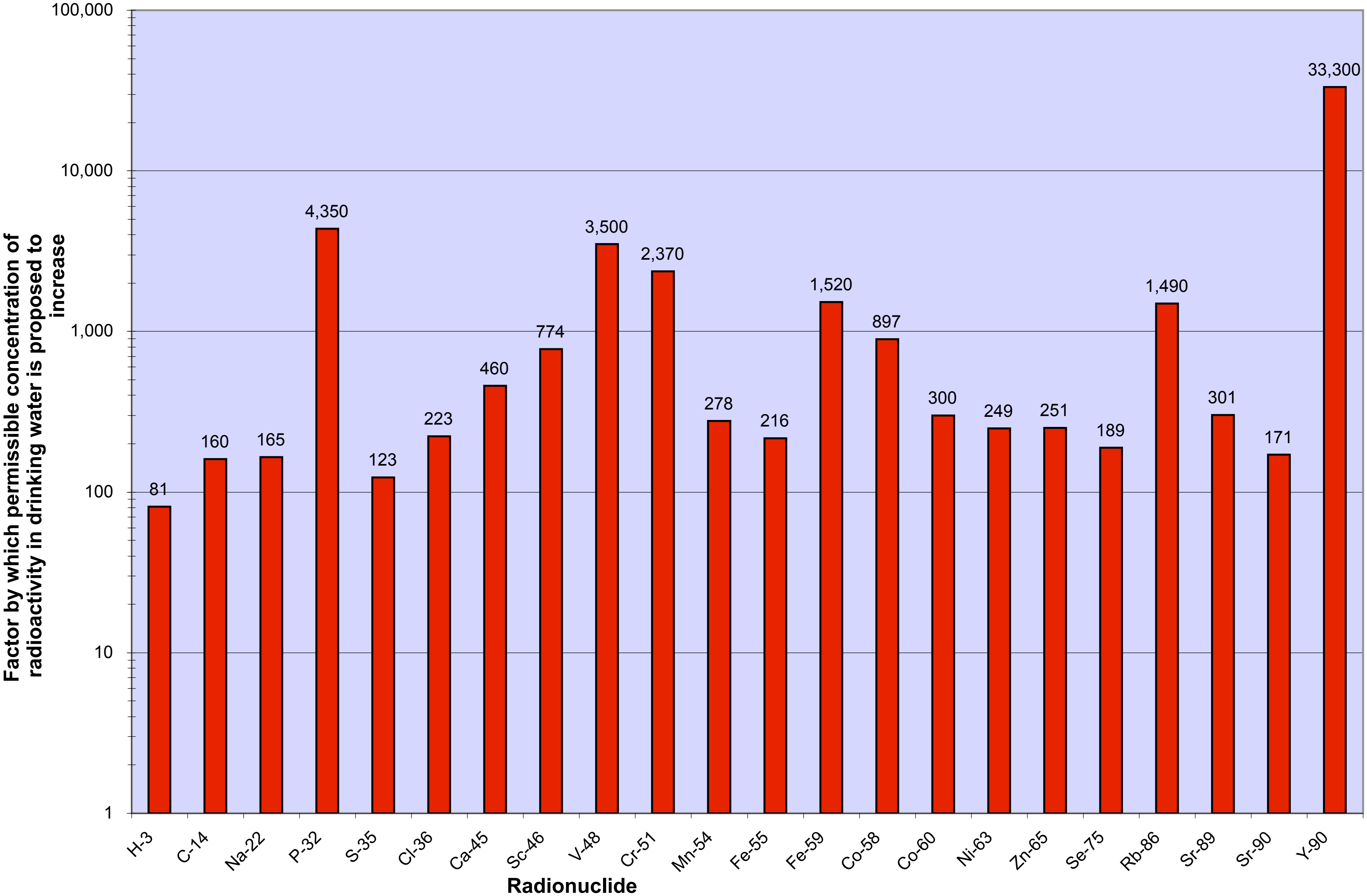
TABLE 3: Proposed Derived Response Level [DRL] (without Decay) vs. Current Maximum Concentration Level [MCL]

Radionuclide	PROPOSED DRL w/o Decay*	CURRENT Maximum Concentration Level (MCL)*	RATIO (Factor by which permissible concentration of radioactivity in drinking water is proposed to increase)
Te-129	2,940,000	2,000	**1,470**
Te-129m	62,300	90	**692**
Te-132	48,600	90	**540**
I-132	48,600	90	**540**
I-129	1,750	1	**1,750**
I-131	8,490	3	**2,830**
Cs-136	60,100	800	**75**
Cs-137	13,600	200	**68**
Ba-140	71,200	90	**791**
La-140	91,600	60	**1,530**
Ce-141	260,000	300	**867**
Ce-143	165,000	100	**1,650**
Ce-144	35,300	30	**1,180**
Nd-147	171,000	200	**855**
Pm-149	186,000	100	**1,860**
Sm-151	1,890,000	1,000	**1,890**
Eu-152	135,000	200	**675**
Eu-154	90,700	60	**1,510**
Eu-155	566,000	600	**943**
Gd-153	665,000	600	**1,110**
Tb-160	115,000	100	**1,150**
Tm-170	140,000	100	**1,400**
Hf-181	165,000	200	**825**
Ta-182	120,000	100	**1,200**
W-187	294,000	200	**1,470**
Ir-192	135,000	100	**1,350**
Au-198	116,900,000	100	**1,170,000**
Hg-203	96,900	60	**1,620**
Tl-204	156,000	300	**520**
Bi-207	146,000	200	**730**

*Units = picoCuries per Liter (pCi/L)

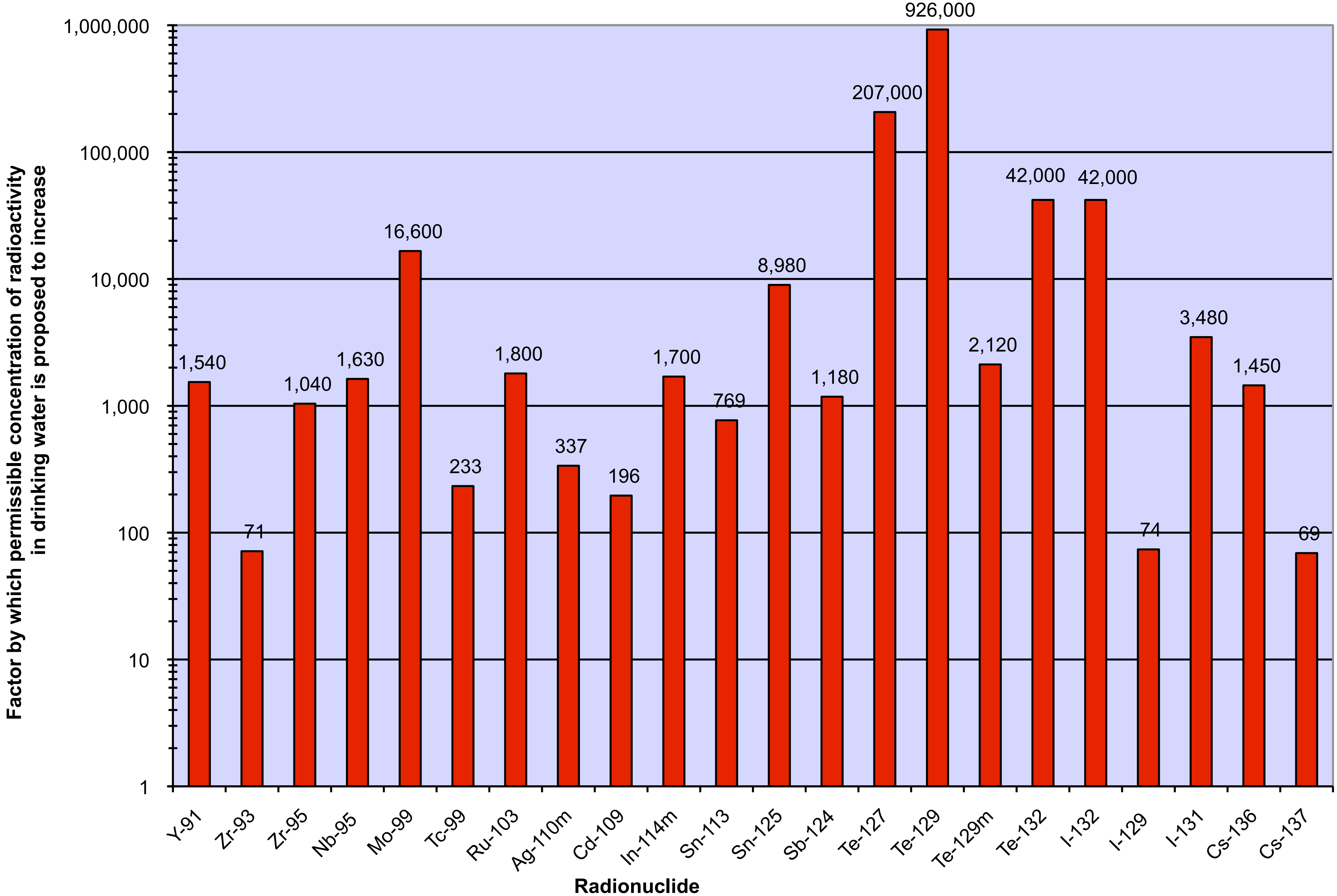
<u>**Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase**</u>

FIGURE 4: Proposed DRL (with Decay) vs. Current Removal Action Level (RAL)

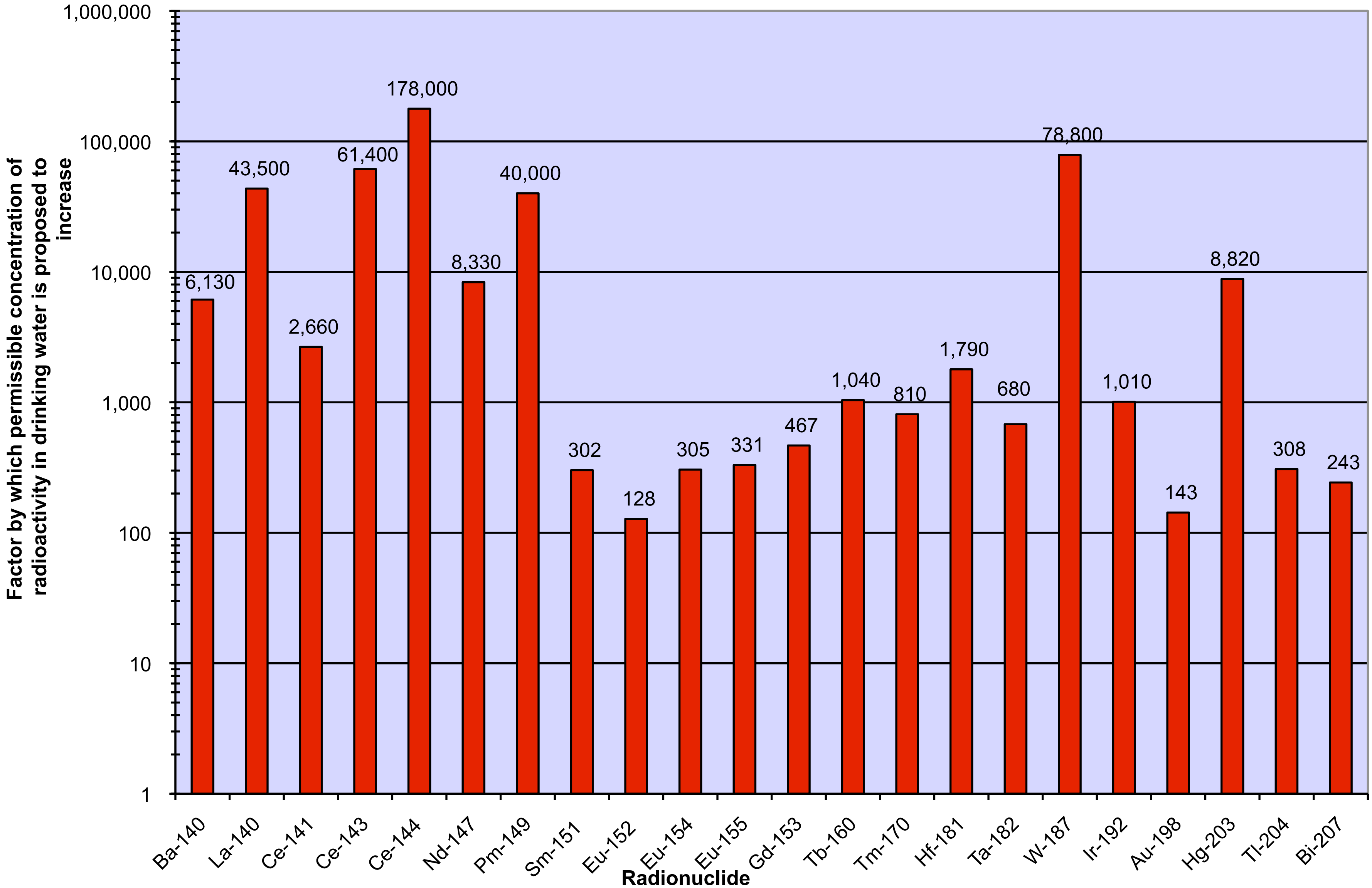


<u>**Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase**</u>

FIGURE 4: Proposed DRL (with Decay) vs. Current Removal Action Level



Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase
FIGURE 4: Proposed DRL (with Decay) vs. Current Removal Action Level



PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

TABLE 4: Proposed Derived Response Level [DRL] (with Decay) vs. Current Removal Action Level [RAL]

Radionuclide	PROPOSED DRL w/ Decay*	CURRENT Removal Action Level (RAL)*	RATIO (Factor by which permissible concentration of RADIOACTIVITY IN DRINKING WATER IS PROPOSED TO INCREASE)
H-3	4,540,000	56,022	**81**
C-14	319,000	2,000	**160**
Na-22	66,100	400	**165**
P-32	1,370,000	315	**4,350**
S-35	731,000	5,960	**123**
Cl-36	199,000	891	**223**
Ca-45	513,000	1,116	**460**
Sc-46	397,000	513	**774**
V-48	1,460,000	417	**3,500**
Cr-51	43,700,000	18,405	**2,370**
Mn-54	374,000	1,345	**278**
Fe-55	631,000	2,924	**216**
Fe-59	591,000	389	**1,520**
Co-58	909,000	1,014	**897**
Co-60	57,600	192	**300**
Ni-63	1,220,000	4,902	**249**
Zn-65	75,400	300	**251**
Se-75	170,000	900	**189**
Rb-86	892,000	600	**1,490**
Sr-89	363,000	1,205	**301**
Sr-90	6,730	39	**171**
Y-90	6,530,000	196	**33,300**
Y-91	341,000	221	**1,540**
Zr-93	167,000	2,339	**71**
Zr-95	773,000	746	**1,040**
Nb-95	2,260,000	1,389	**1,630**
Mo-99	28,100,000	1,696	**16,600**
Tc-99	288,000	1,236	**233**
Ru-103	1,620,000	901	**1,800**
Ag-110m	106,000	315	**337**
Cd-109	120,000	612	**196**
In-114m	233,000	137	**1,700**
Sn-113	620,000	807	**769**
Sn-125	1,580,000	176	**8,980**
Sb-124	311,000	264	**1,180**
Te-127	712,000,000	3,435	**207,000**

*Units = picoCuries per Liter (pCi/L)

PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

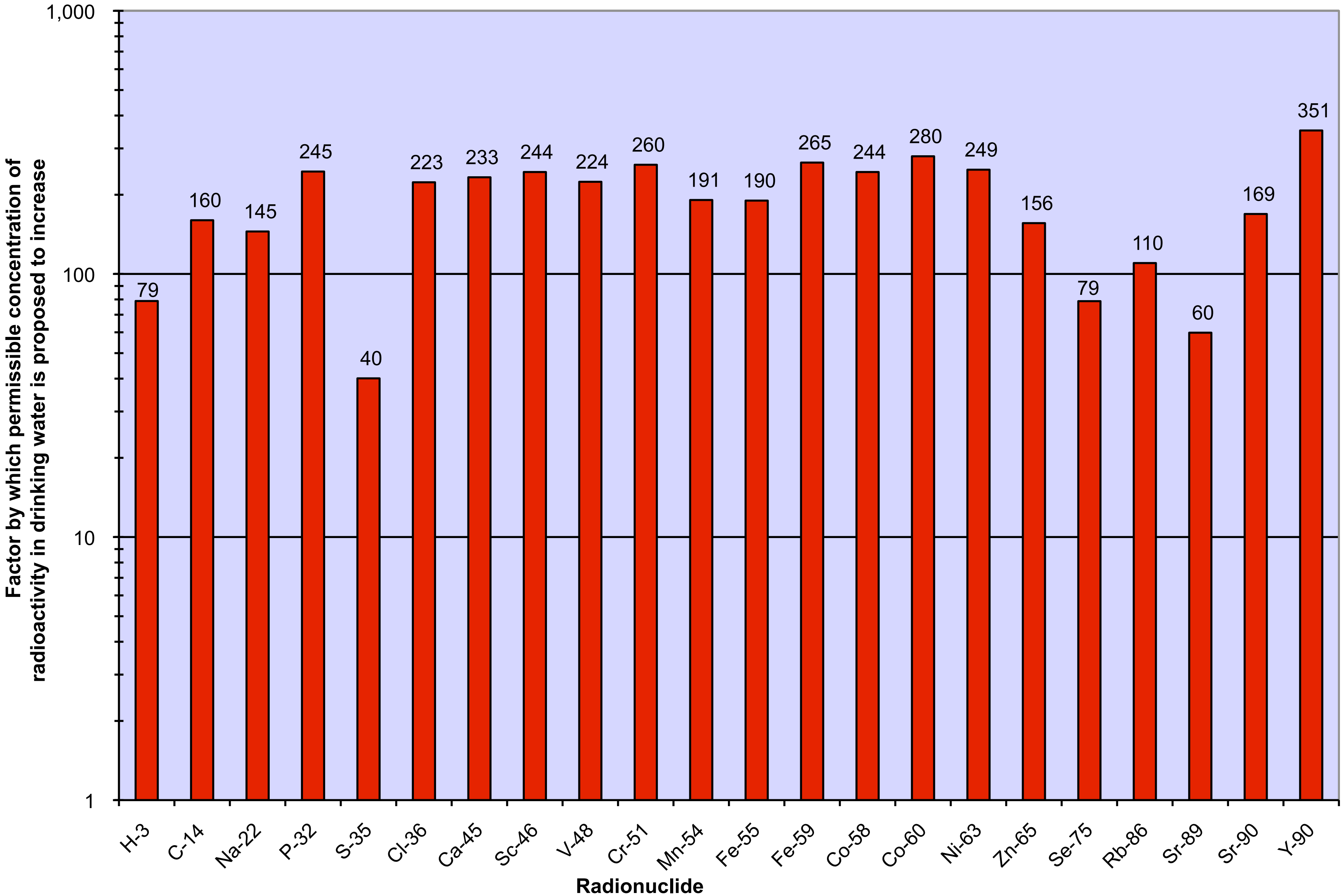
TABLE 4: Proposed Derived Response Level [DRL] (with Decay) vs. Current Removal Action Level [RAL]

Radionuclide	PROPOSED DRL w/ Decay*	CURRENT Removal Action Level (RAL)*	RATIO (Factor by which permissible concentration of RADIOACTIVITY IN DRINKING WATER IS PROPOSED TO INCREASE)
Te-129	15,300,000,000	16,529	**926,000**
Te-129m	468,000	221	**2,120**
Te-132	3,780,000	90	**42,000**
I-132	3,780,000	90	**42,000**
I-129	1,750	24	**74**
I-131	267,000	77	**3,480**
Cs-136	1,160,000	800	**1,450**
Cs-137	13,800	200	**69**
Ba-140	1,410,000	230	**6,130**
La-140	13,800,000	318	**43,500**
Ce-141	2,030,000	763	**2,660**
Ce-143	30,400,000	495	**61,400**
Ce-144	5,330,000	30	**178,000**
Nd-147	3,940,000	473	**8,330**
Pm-149	21,300,000	532	**40,000**
Sm-151	1,890,000	6,250	**302**
Eu-152	139,000	1,087	**128**
Eu-154	94,300	309	**305**
Eu-155	607,000	1,835	**331**
Gd-153	1,070,000	2,290	**467**
Tb-160	415,000	400	**1,040**
Tm-170	320,000	395	**810**
Hf-181	984,000	550	**1,790**
Ta-182	297,000	437	**680**
W-187	74,700,000	948	**78,800**
Ir-192	477,000	472	**1,010**
Au-198	80,000	559	**143**
Hg-203	529,000	60	**8,820**
Tl-204	170,000	553	**308**
Bi-207	147,000	604	**243**

*Units = picoCuries per Liter (pCi/L)

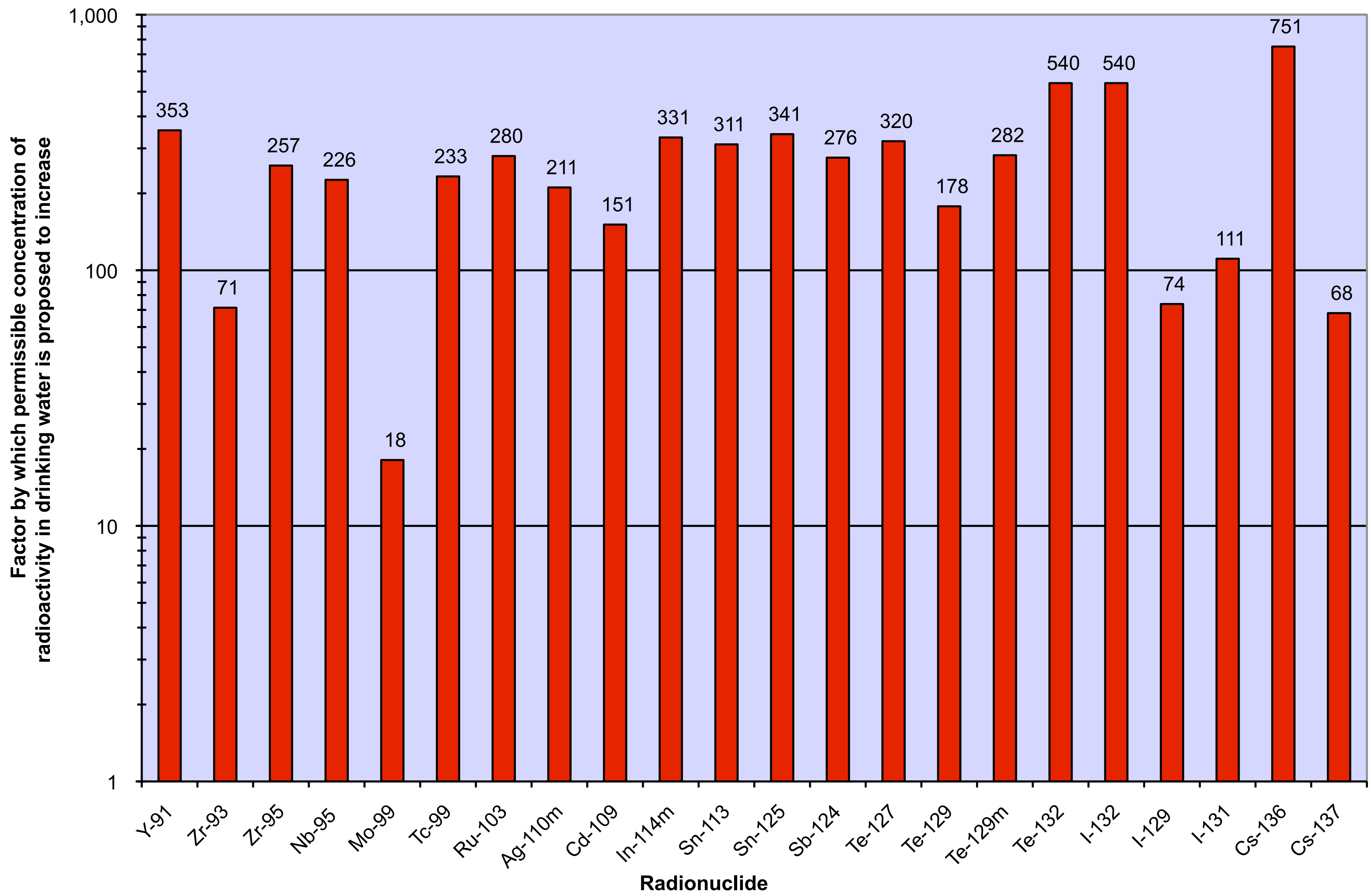
<u>Factor by which Allowable Radioactibity in Drinking Water is Proposed to Increase</u>

FIGURE 5: Proposed DRL (without Decay) vs. Current Removal Action Level (RAL)



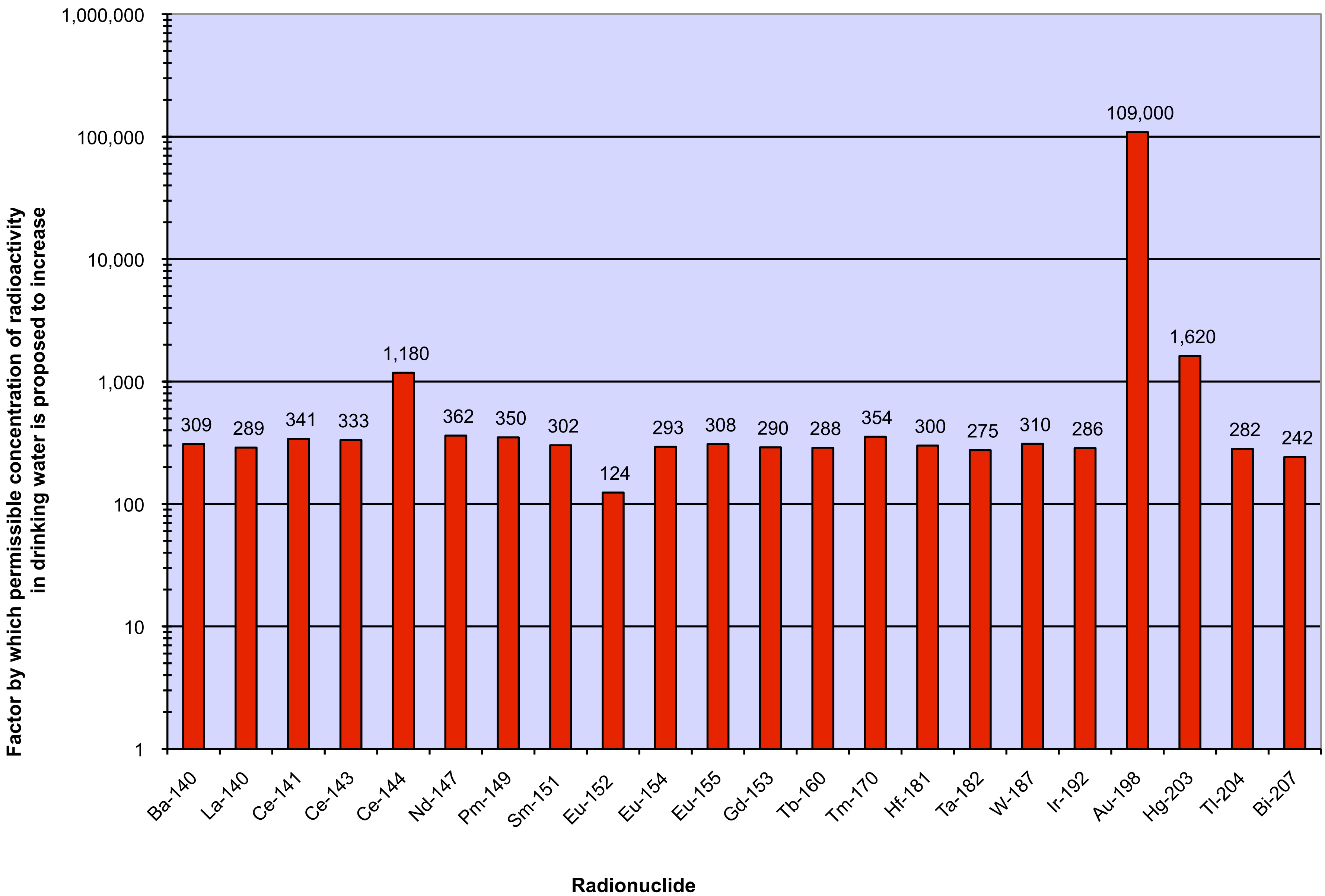
<u>Factor by which Allowable Radioactibity in Drinking Water is Proposed to Increase</u>

FIGURE 5: Proposed DRL (without Decay) vs. Current Removal Action Level (RAL)



<u>**Factor by which Allowable Radioactibity in Drinking Water is Proposed to Increase**</u>

FIGURE 5: Proposed DRL (without Decay) vs. Current Removal Action Level (RAL)



PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

TABLE 5: Proposed Derived Response Level [DRL] (without Decay) vs. Current Removal Action Level [RAL]

Radionuclide	PROPOSED DRL w/o Decay*	CURRENT Removal Action Level (RAL)*	RATIO (Factor by which permissible concentration of RADIOACTIVITY IN DRINKING WATER IS PROPOSED TO INCREASE)
H-3	4,420,000	56,022	**79**
C-14	319,000	2,000	**160**
Na-22	58,000	400	**145**
P-32	77,100	315	**245**
S-35	239,000	5,960	**40**
Cl-36	199,000	891	**223**
Ca-45	260,000	1,116	**233**
Sc-46	125,000	513	**244**
V-48	93,400	417	**224**
Cr-51	4,790,000	18,405	**260**
Mn-54	257,000	1,345	**191**
Fe-55	557,000	2,924	**190**
Fe-59	103,000	389	**265**
Co-58	247,000	1,014	**244**
Co-60	53,900	192	**280**
Ni-63	1,220,000	4,902	**249**
Zn-65	46,900	300	**156**
Se-75	70,900	900	**79**
Rb-86	65,900	600	**110**
Sr-89	72,000	1,205	**60**
Sr-90	6,650	39	**169**
Y-90	68,800	196	**351**
Y-91	78,100	221	**353**
Zr-93	167,000	2,339	**71**
Zr-95	192,000	746	**257**
Nb-95	314,000	1,389	**226**
Mo-99	306,000	16,946	**18**
Tc-99	288,000	1,236	**233**
Ru-103	252,000	901	**280**
Ag-110m	66,500	315	**211**
Cd-109	92,600	612	**151**
In-114m	45,400	137	**331**
Sn-113	251,000	807	**311**
Sn-125	60,100	176	**341**
Sb-124	72,900	264	**276**
Te-127	1,100,000	3,435	**320**

*Units = picoCuries per Liter (pCi/L)

PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

TABLE 5: Proposed Derived Response Level [DRL] (without Decay) vs. Current Removal Action Level [RAL]

Radionuclide	PROPOSED DRL w/o Decay*	CURRENT Removal Action Level (RAL)*	RATIO (Factor by which permissible concentration of RADIOACTIVITY IN DRINKING WATER IS PROPOSED TO INCREASE)
Te-129	2,940,000	16,529	**178**
Te-129m	62,300	221	**282**
Te-132	48,600	90	**540**
I-132	48,600	90	**540**
I-129	1,750	24	**74**
I-131	8,490	77	**111**
Cs-136	60,100	800	**751**
Cs-137	13,600	200	**68**
Ba-140	71,200	230	**309**
La-140	91,600	318	**289**
Ce-141	260,000	763	**341**
Ce-143	165,000	495	**333**
Ce-144	35,300	30	**1,180**
Nd-147	171,000	473	**362**
Pm-149	186,000	532	**350**
Sm-151	1,890,000	6,250	**302**
Eu-152	135,000	1,087	**124**
Eu-154	90,700	309	**293**
Eu-155	566,000	1,835	**308**
Gd-153	665,000	2,290	**290**
Tb-160	115,000	400	**288**
Tm-170	140,000	395	**354**
Hf-181	165,000	550	**300**
Ta-182	120,000	437	**275**
W-187	294,000	948	**310**
Ir-192	135,000	472	**286**
Au-198	116,900,000	559	**109,000**
Hg-203	96,900	60	**1,620**
Tl-204	156,000	553	**282**
Bi-207	146,000	604	**242**

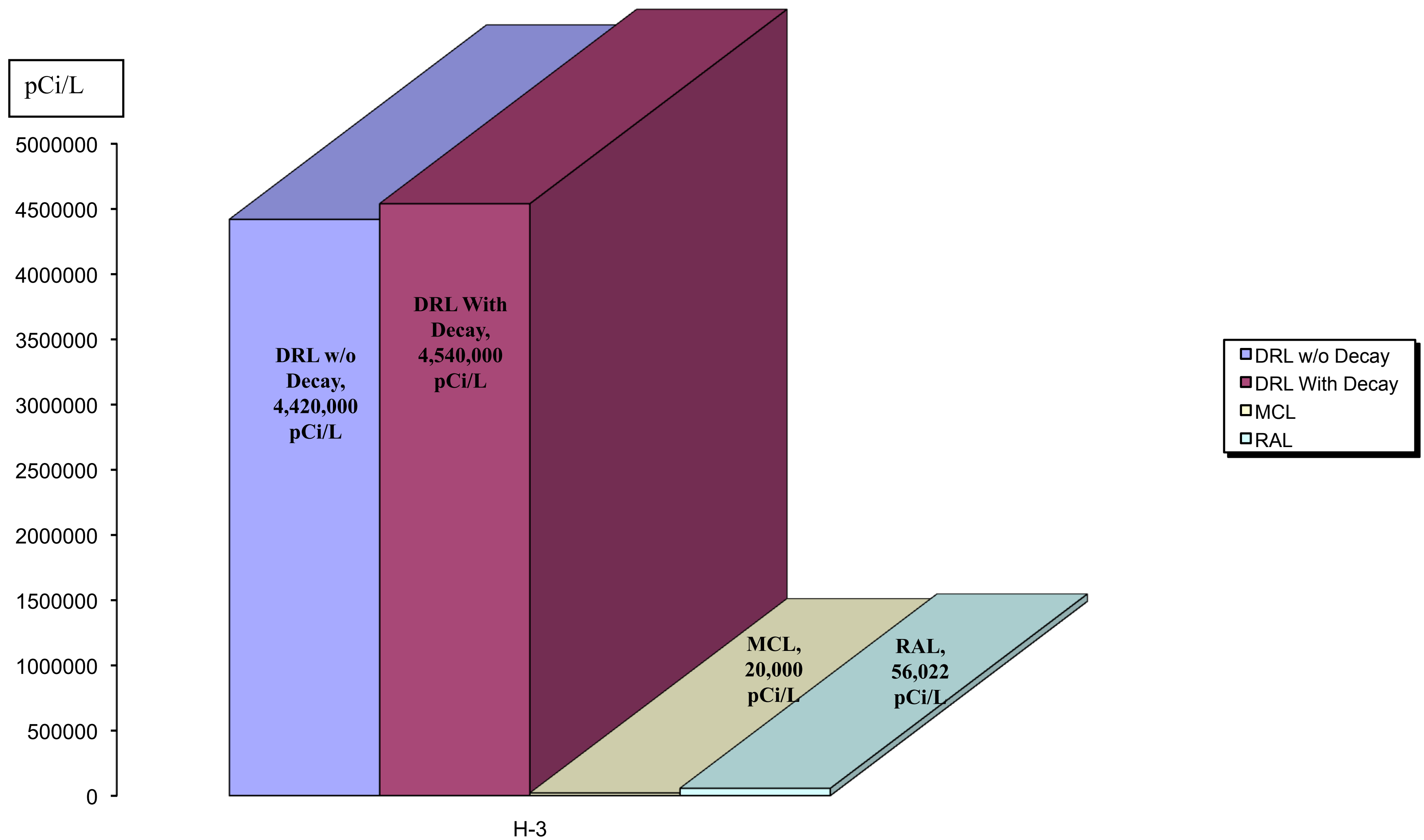
*Units = picoCuries per Liter (pCi/L)

RADIONUCLIDE BY RADIONUCLIDE COMPARISON

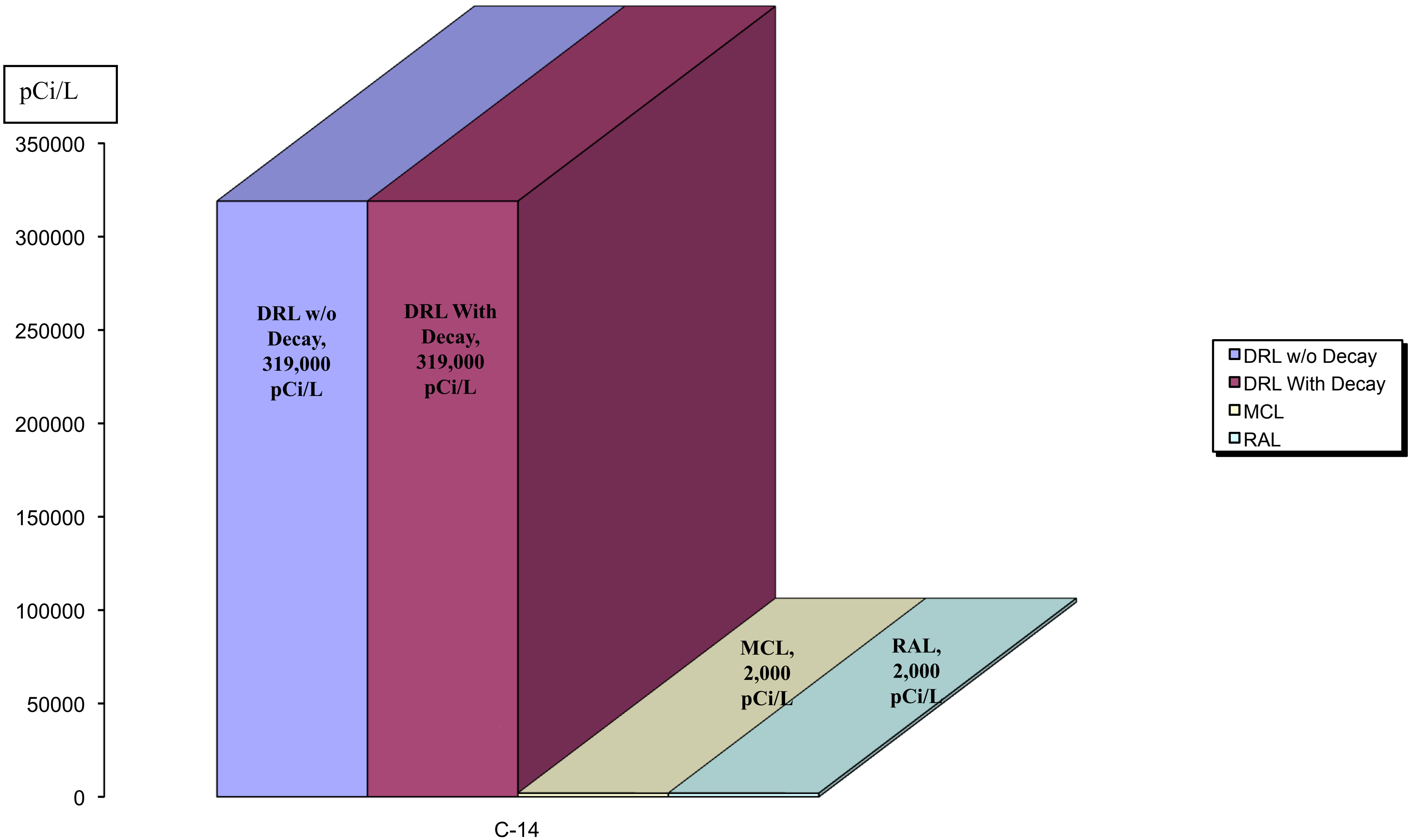
PROPOSED NEW PERMISSIBLE CONCENTRATIONS OF RADIONUCLIDES IN DRINKING WATER (DRLs)

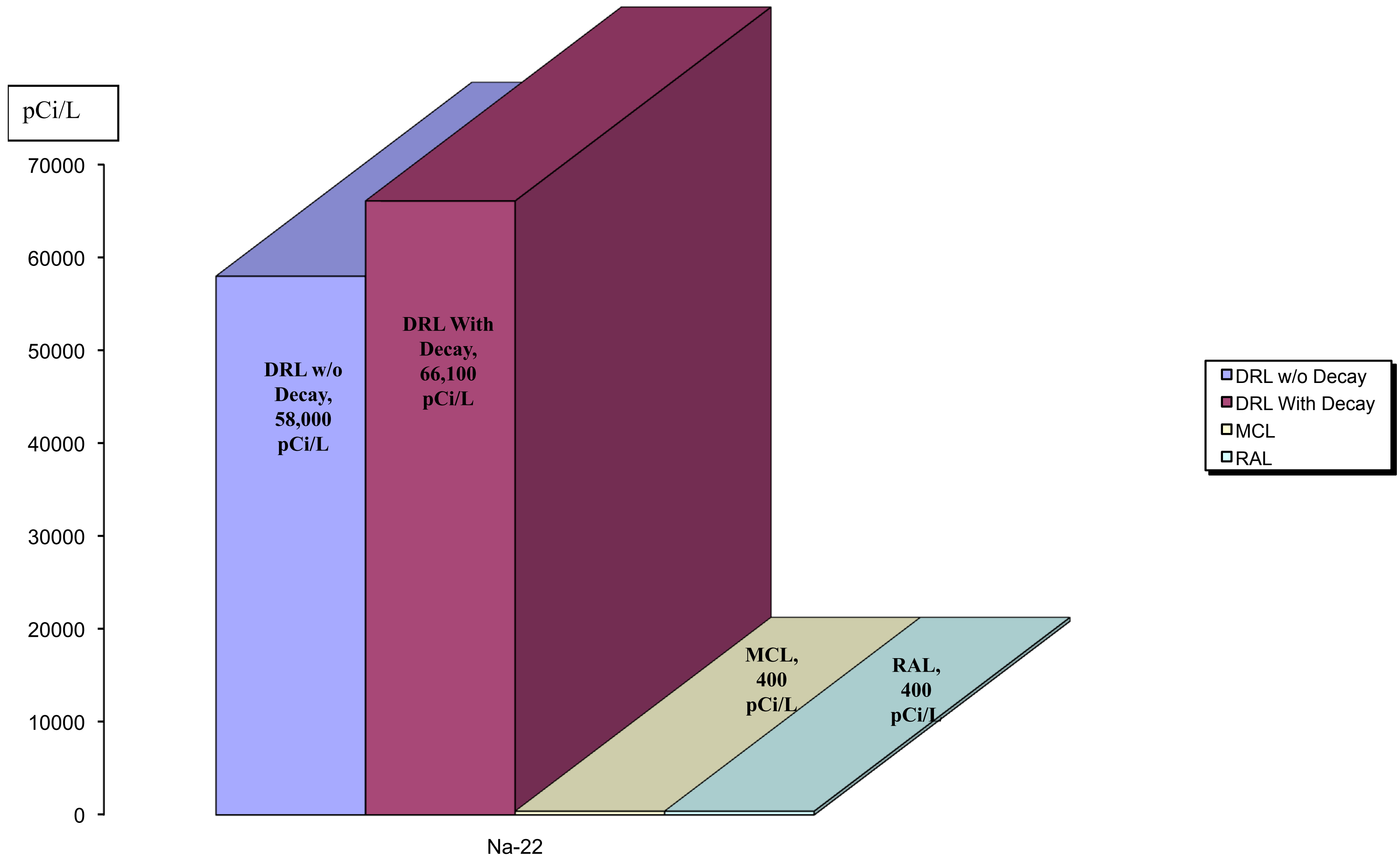
VS.

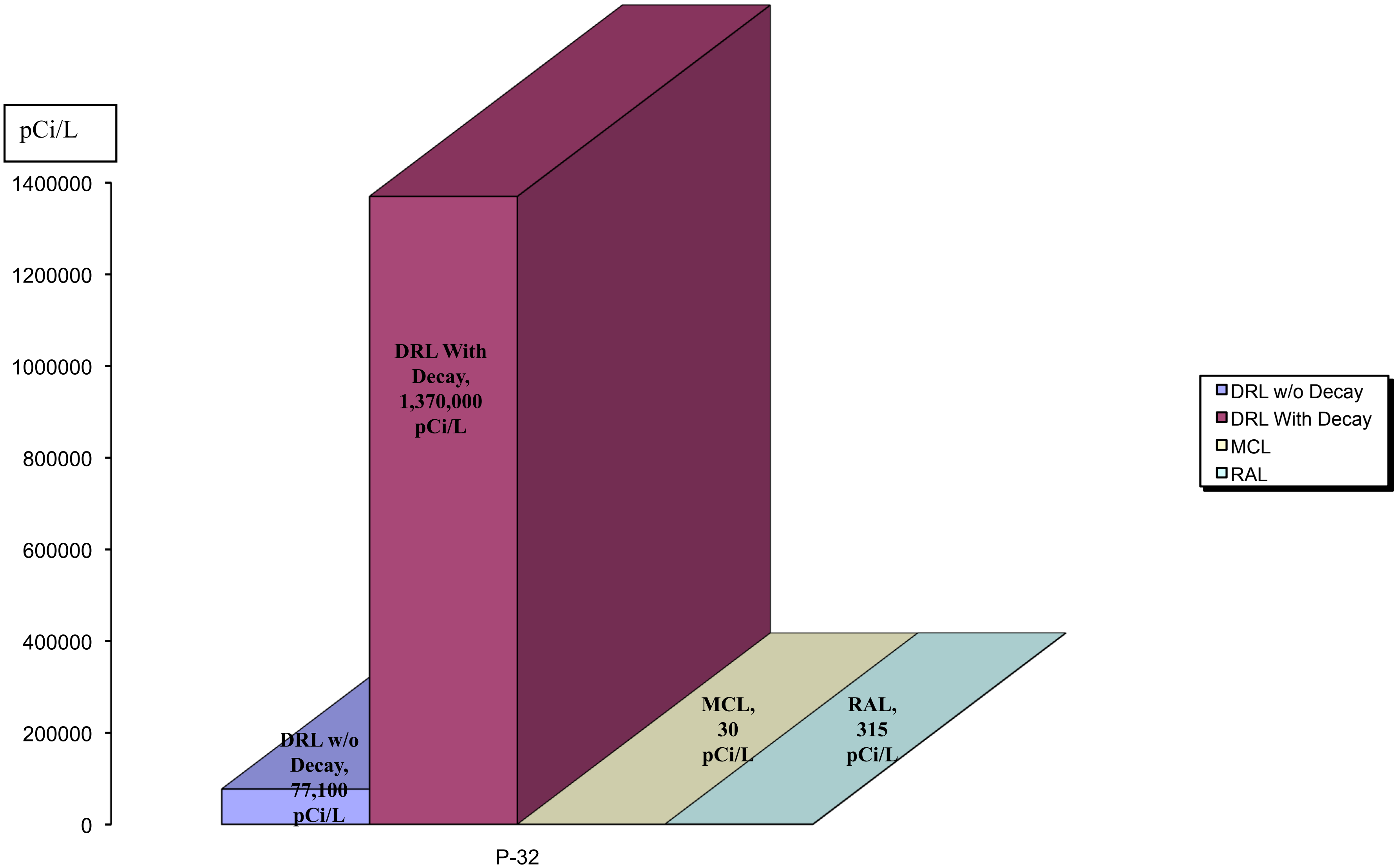
EPA's LONGSTANDING DRINKING WATER STANDARDS (MCLs) AND (RALs)

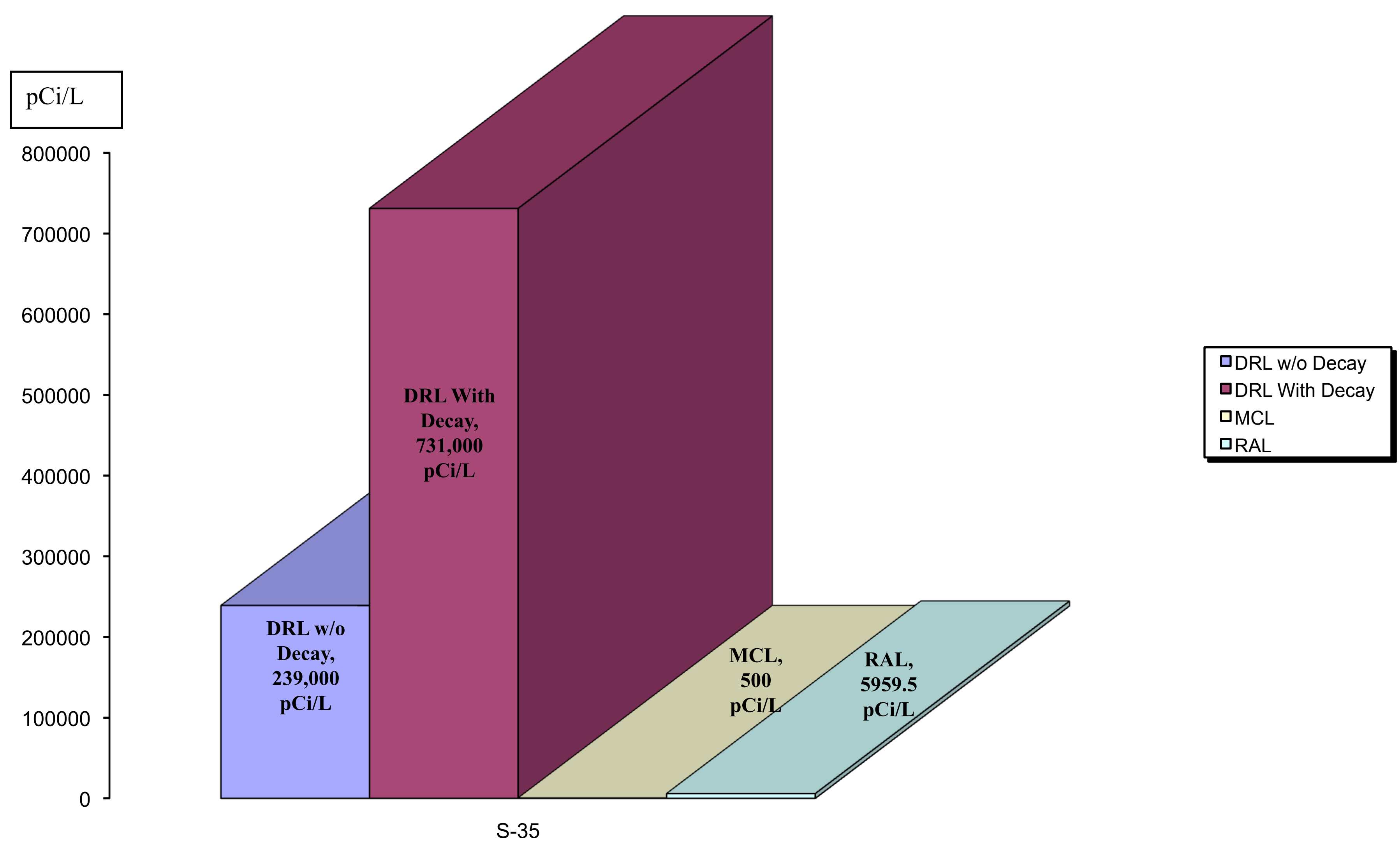


pCi/L
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
DRL w/o Decay, 4,420,000 pCi/L
DRL With Decay, 4,540,000 pCi/L
MCL, 20,000 pCi/L
RAL, 56,022 pCi/L
H-3
DRL w/o Decay
DRL With Decay
MCL
RAL

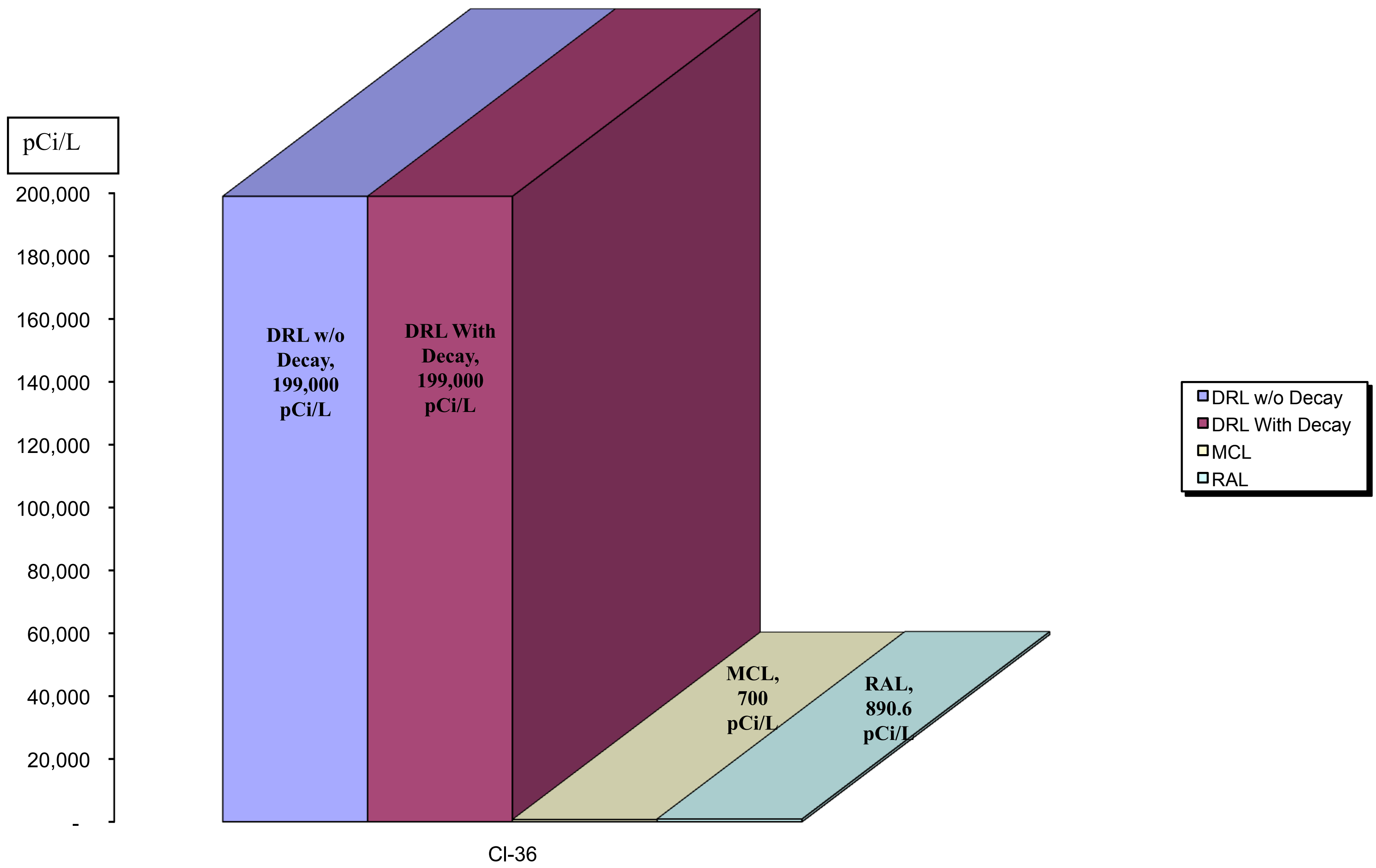

pCi/L
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 319,000 pCi/L
DRL With Decay, 319,000 pCi/L
MCL, 2,000 pCi/L
RAL, 2,000 pCi/L
C-14
DRL w/o Decay
DRL With Decay
MCL
RAL

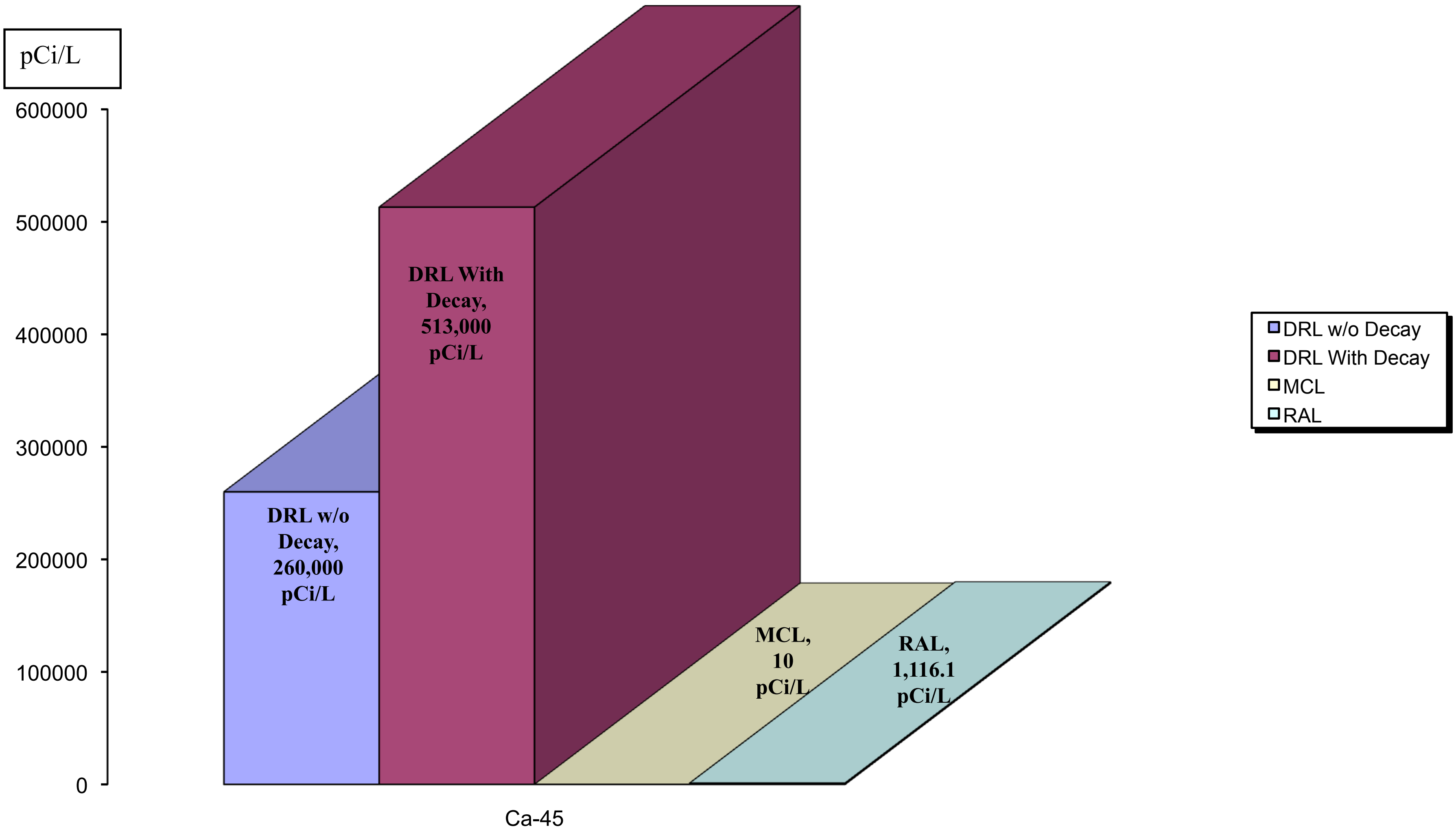

pCi/L
70000
60000
50000
40000
30000
20000
10000
0
DRL w/o Decay, 58,000 pCi/L
DRL With Decay, 66,100 pCi/L
MCL, 400 pCi/L
RAL, 400 pCi/L
Na-22
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
1400000
1200000
1000000
800000
600000
400000
200000
0
DRL With Decay, 1,370,000 pCi/L
DRL w/o Decay, 77,100 pCi/L
MCL, 30 pCi/L
RAL, 315 pCi/L
P-32
DRL w/o Decay
DRL With Decay
MCL
RAL

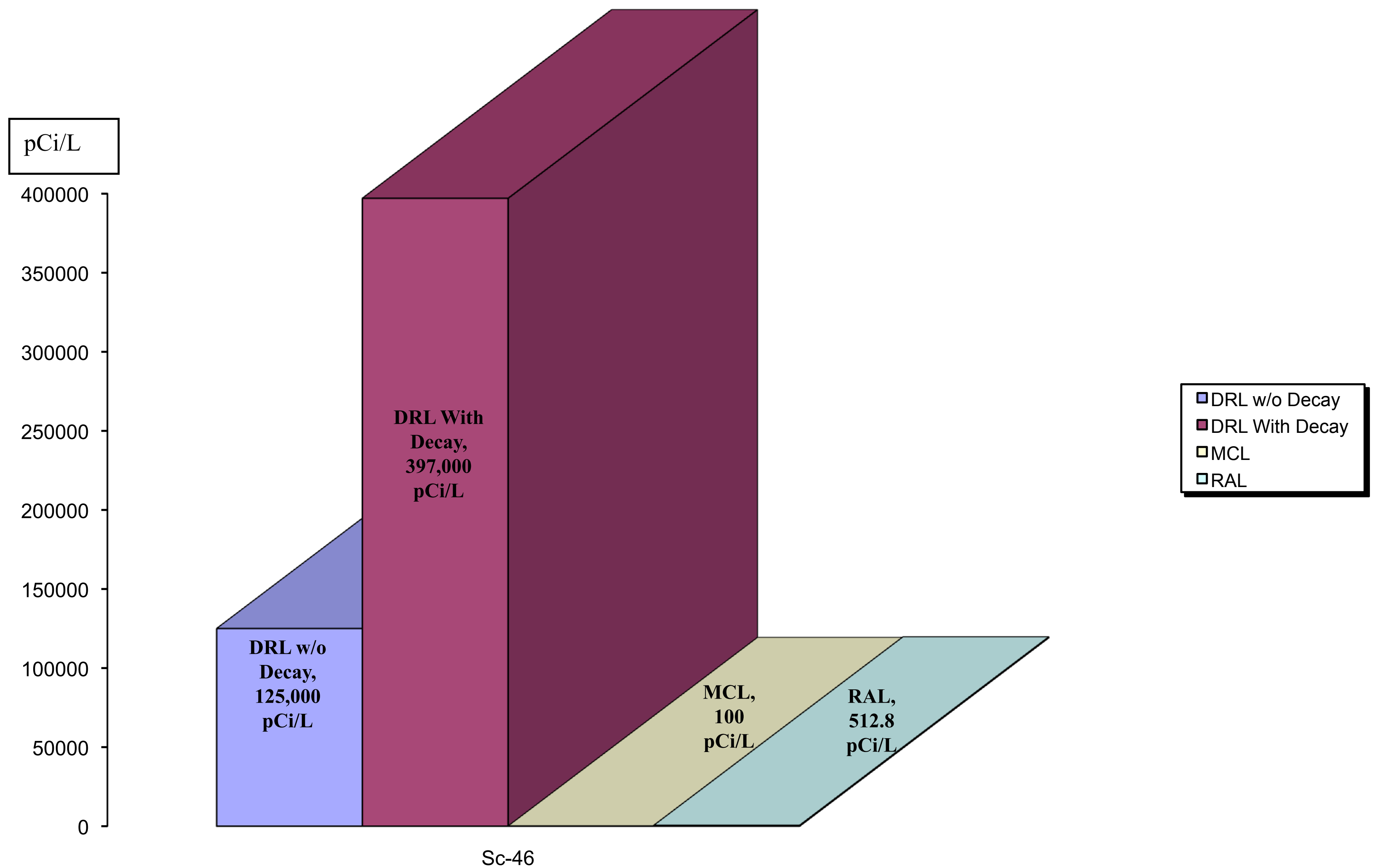


pCi/L
800000
700000
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 239,000 pCi/L
DRL With Decay, 731,000 pCi/L
MCL, 500 pCi/L
RAL, 5959.5 pCi/L
S-35
DRL w/o Decay
DRL With Decay
MCL
RAL

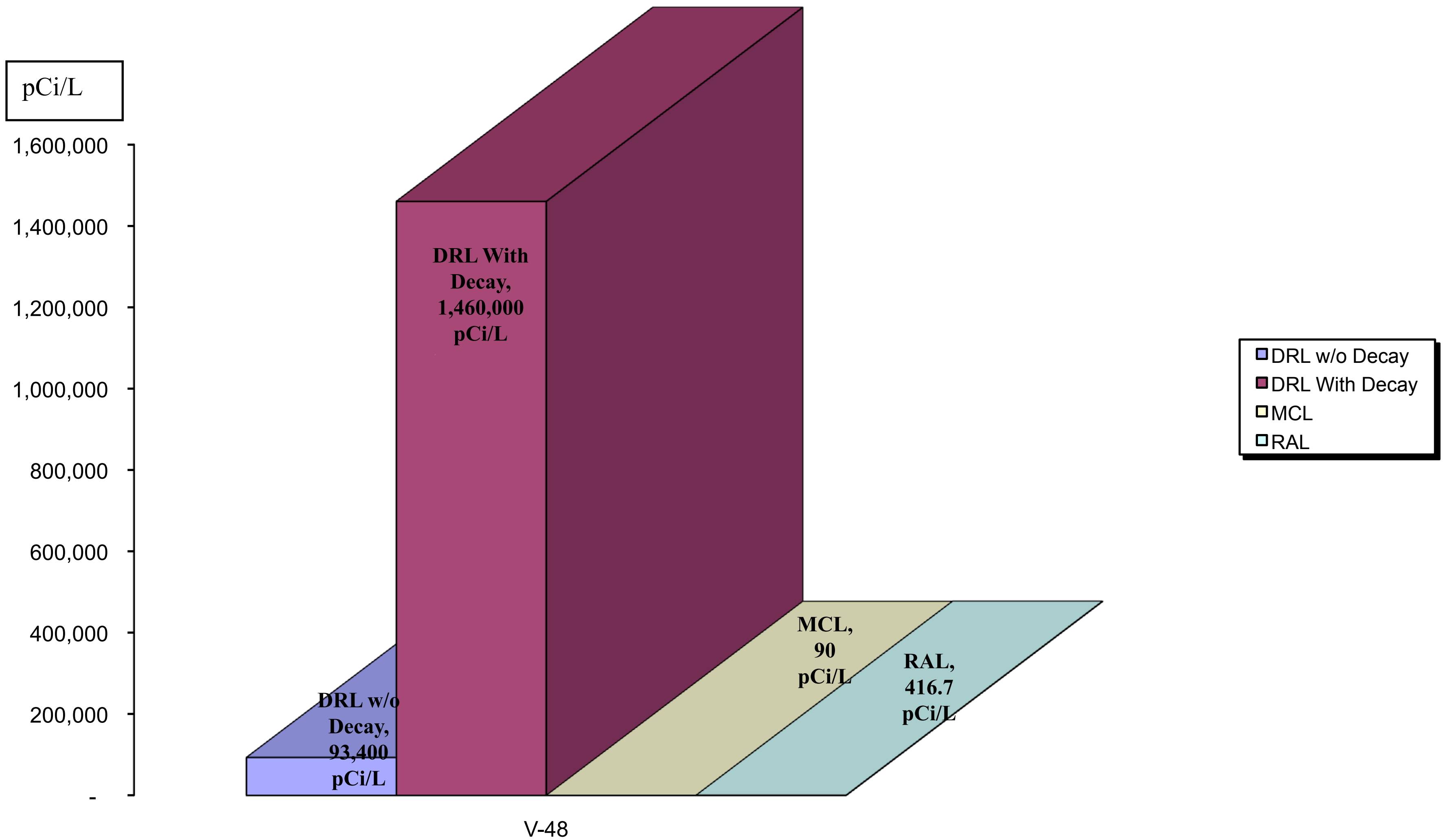

pCi/L
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
DRL w/o Decay, 199,000 pCi/L
DRL With Decay, 199,000 pCi/L
MCL, 700 pCi/L
RAL, 890.6 pCi/L
Cl-36
DRL w/o Decay
DRL With Decay
MCL
RAL

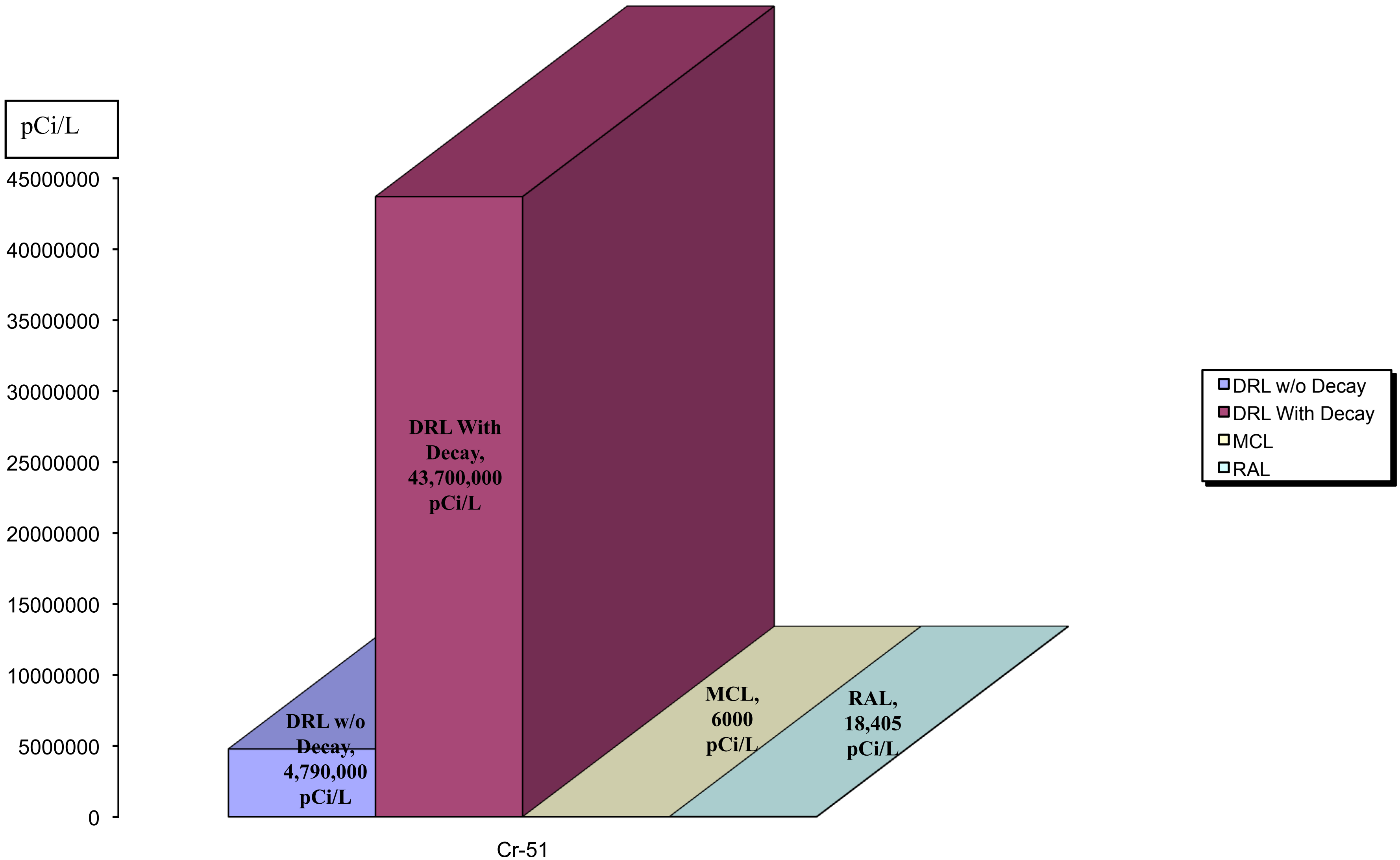


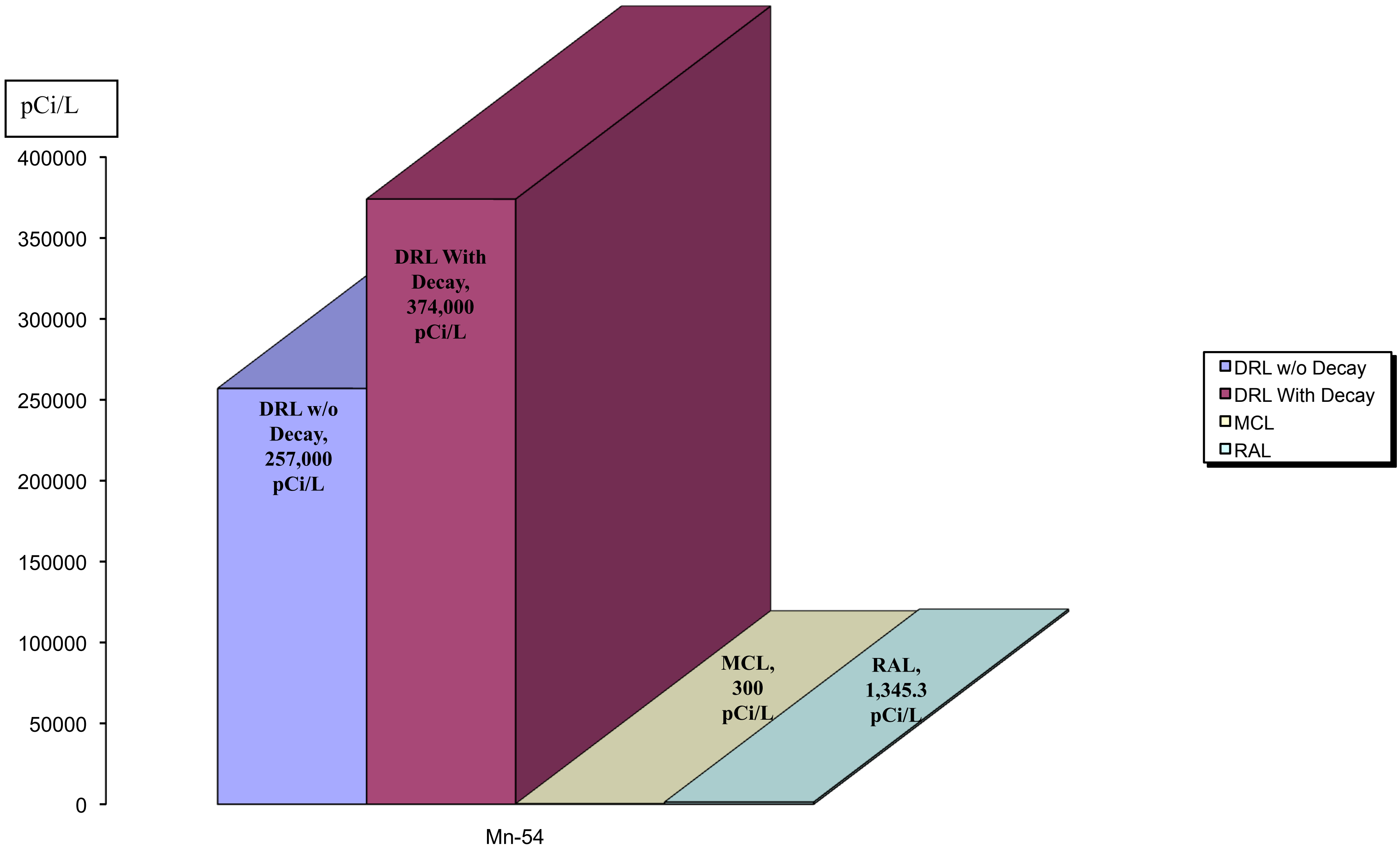
pCi/L
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 260,000 pCi/L
DRL With Decay, 513,000 pCi/L
MCL, 10 pCi/L
RAL, 1,116.1 pCi/L
Ca-45
DRL w/o Decay
DRL With Decay
MCL
RAL

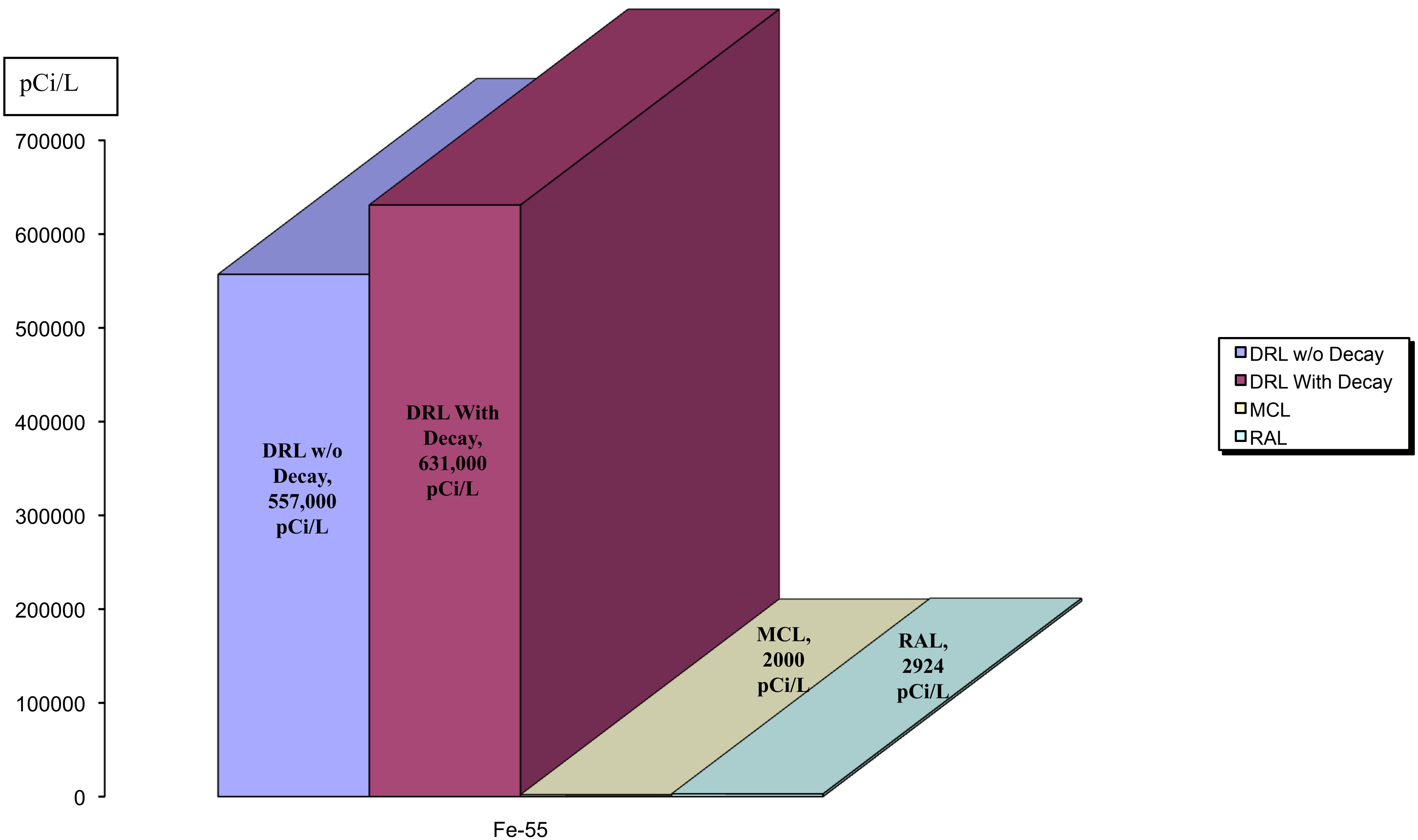


pCi/L
400000
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 125,000 pCi/L
DRL With Decay, 397,000 pCi/L
MCL, 100 pCi/L
RAL, 512.8 pCi/L
Sc-46
DRL w/o Decay
DRL With Decay
MCL
RAL

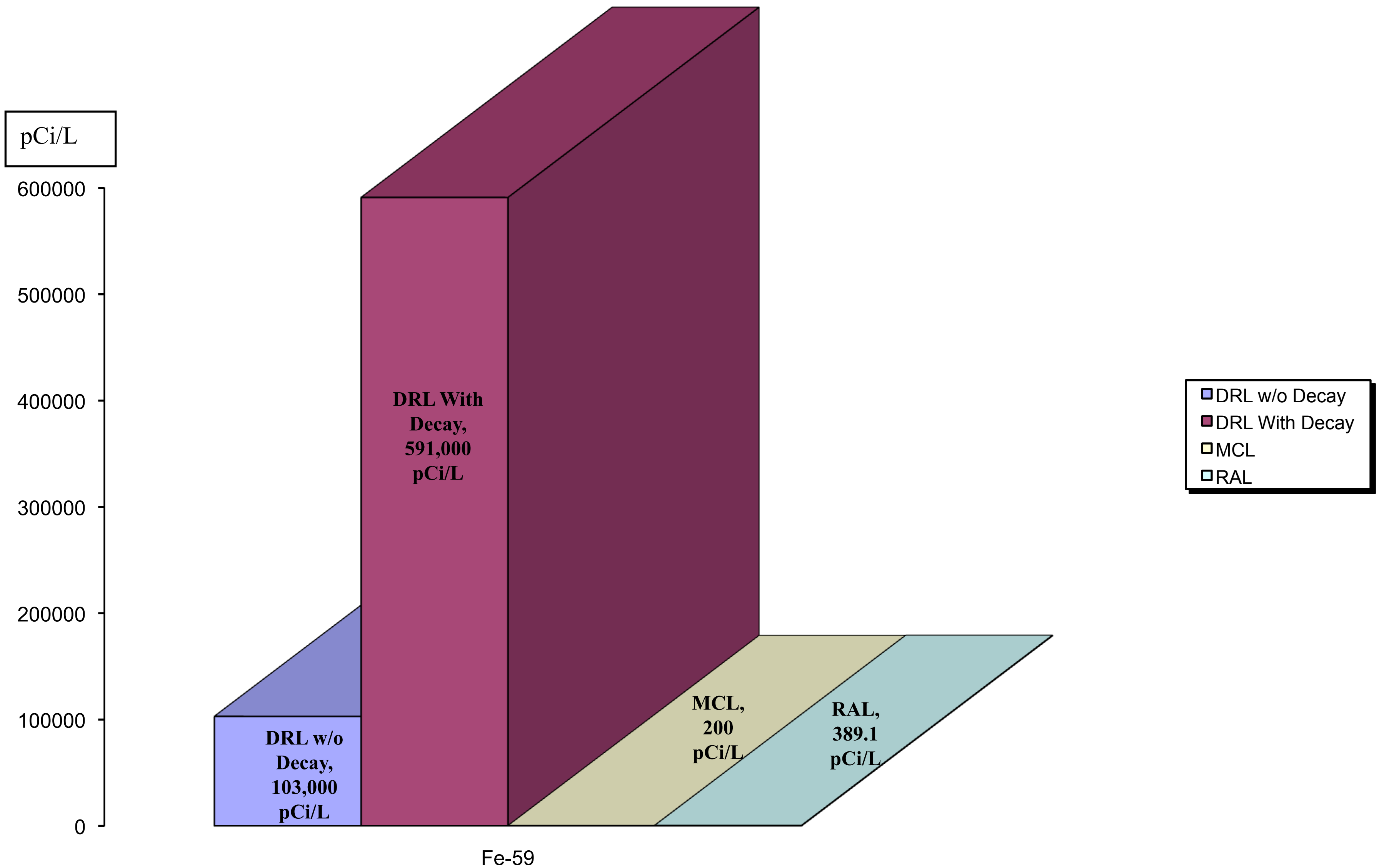

pCi/L
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
-
DRL With Decay, 1,460,000 pCi/L
DRL w/o Decay, 93,400 pCi/L
MCL, 90 pCi/L
RAL, 416.7 pCi/L
V-48
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
45000000
40000000
35000000
30000000
25000000
20000000
15000000
10000000
5000000
0
DRL With Decay, 43,700,000 pCi/L
DRL w/o Decay, 4,790,000 pCi/L
MCL, 6000 pCi/L
RAL, 18,405 pCi/L
Cr-51
DRL w/o Decay
DRL With Decay
MCL
RAL

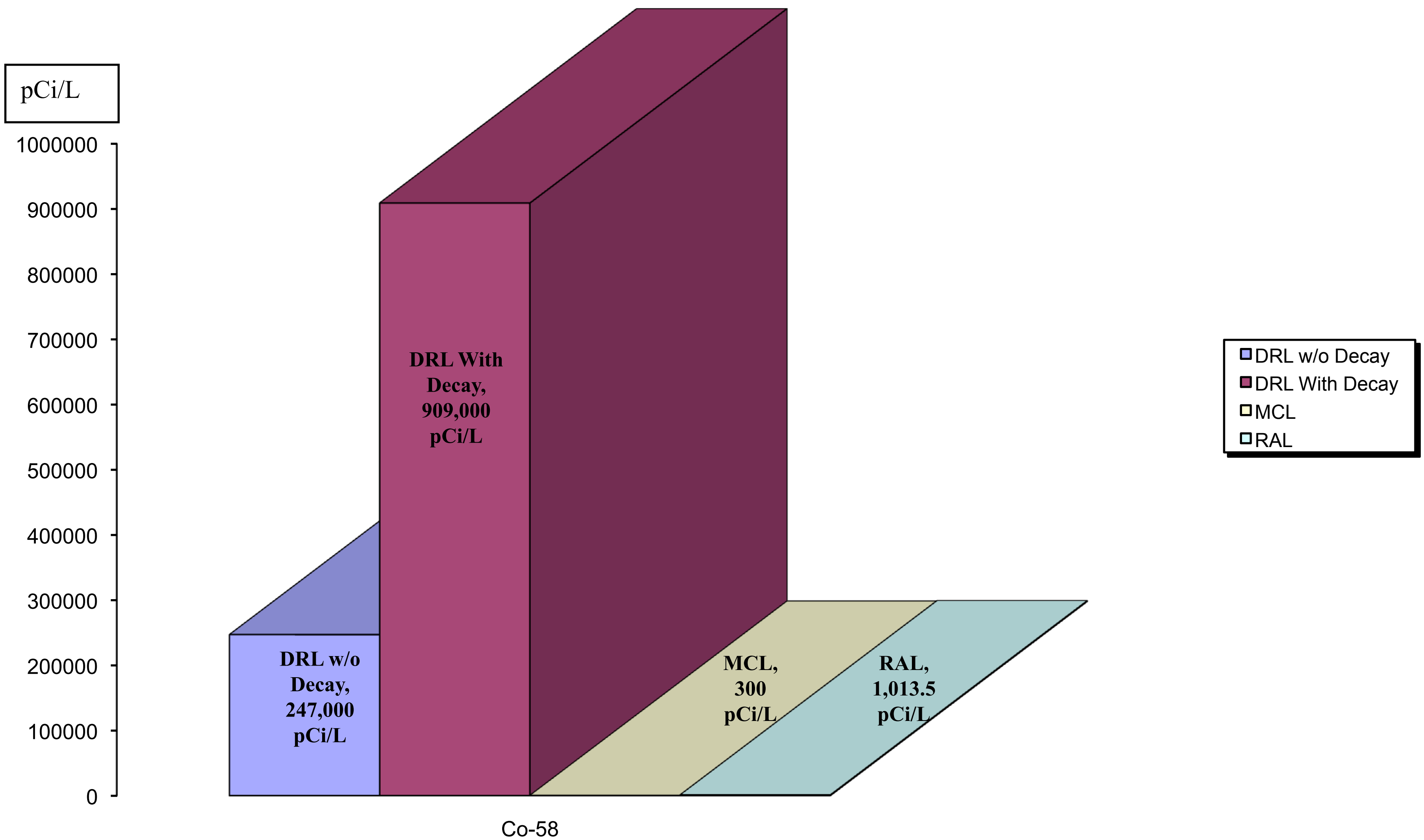

pCi/L
400000
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 257,000 pCi/L
DRL With Decay, 374,000 pCi/L
MCL, 300 pCi/L
RAL, 1,345.3 pCi/L
Mn-54
DRL w/o Decay
DRL With Decay
MCL
RAL

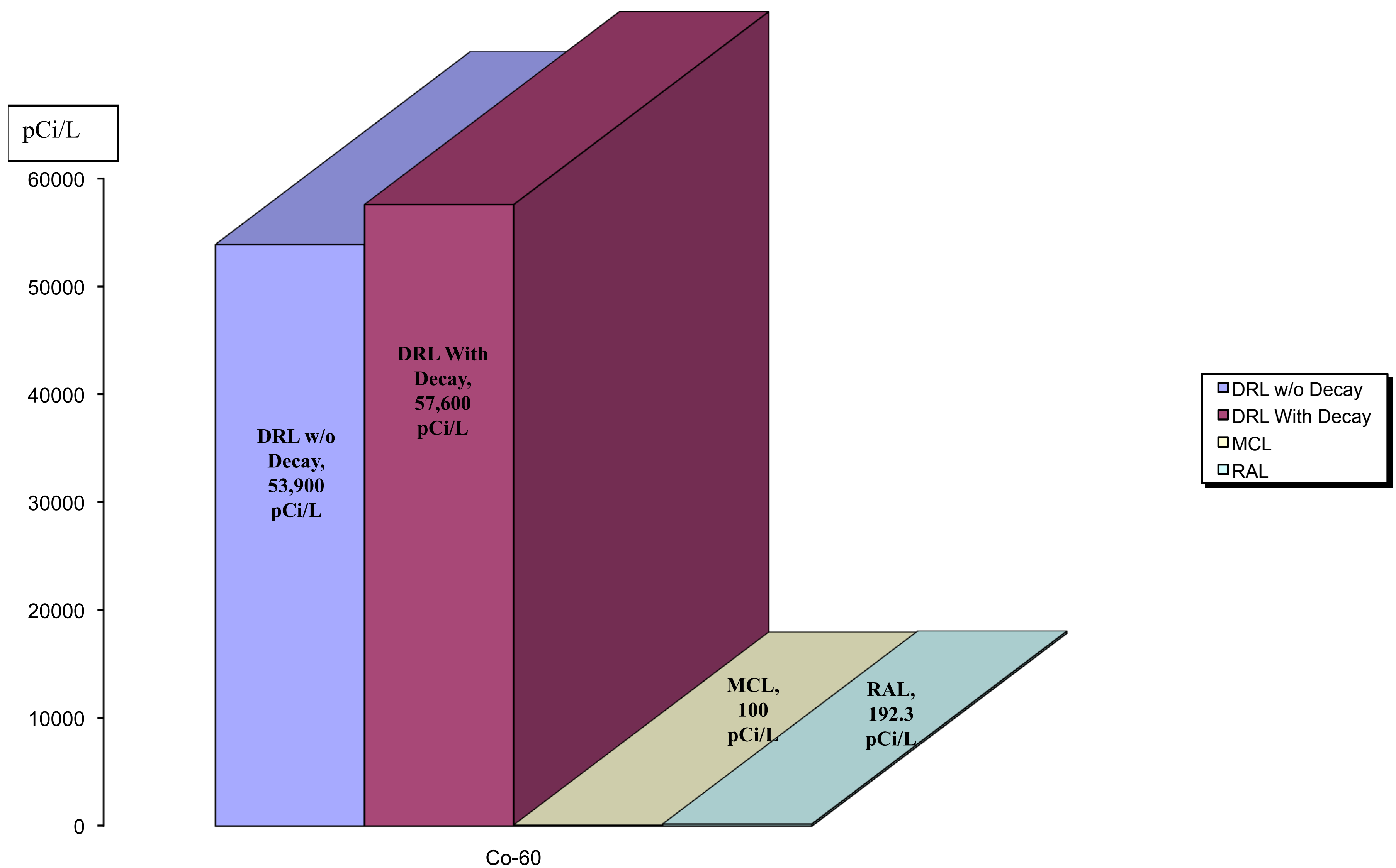


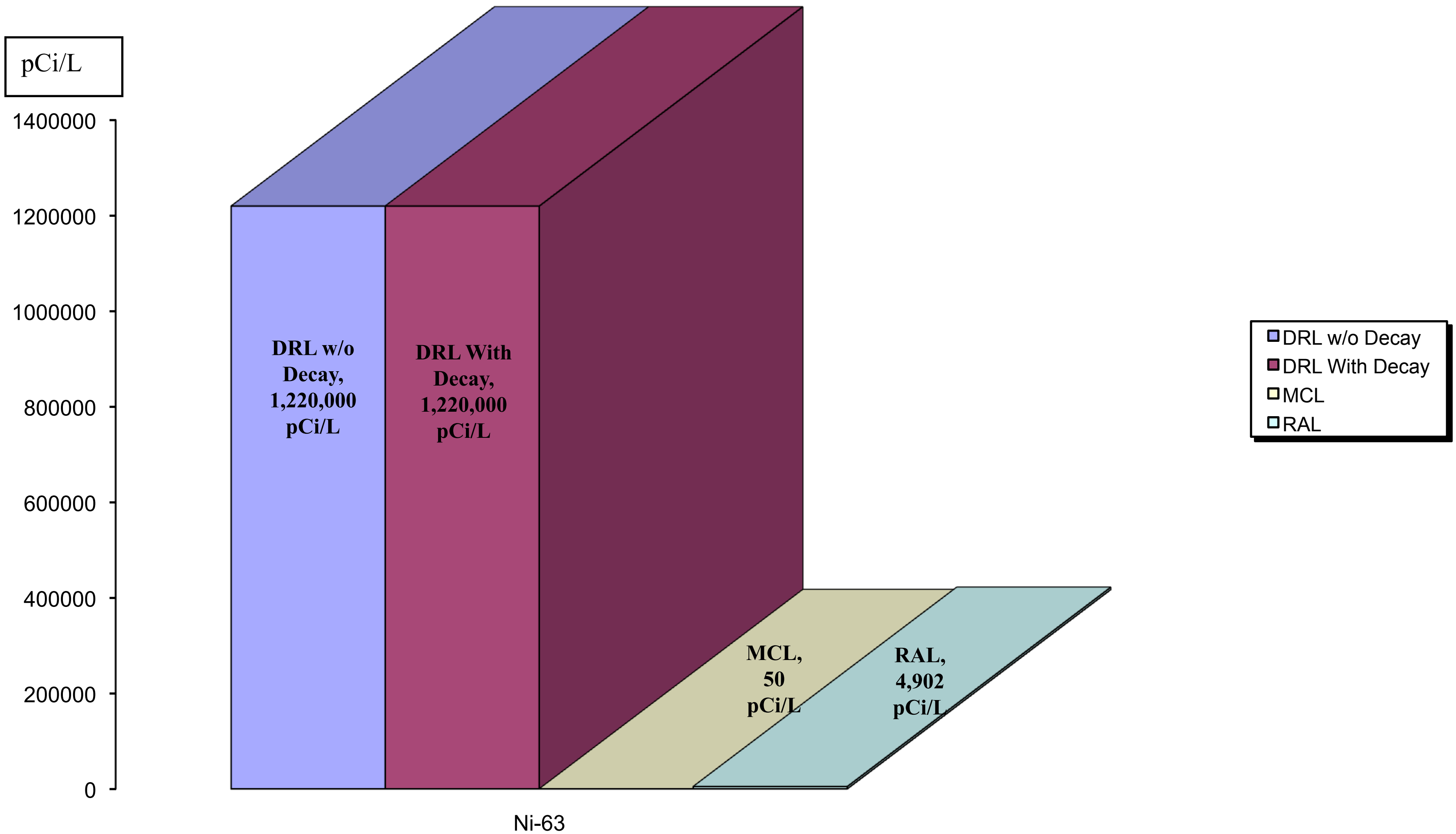
pCi/L
700000
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 557,000 pCi/L
DRL With Decay, 631,000 pCi/L
MCL, 2000 pCi/L
RAL, 2924 pCi/L
Fe-55
DRL w/o Decay
DRL With Decay
MCL
RAL

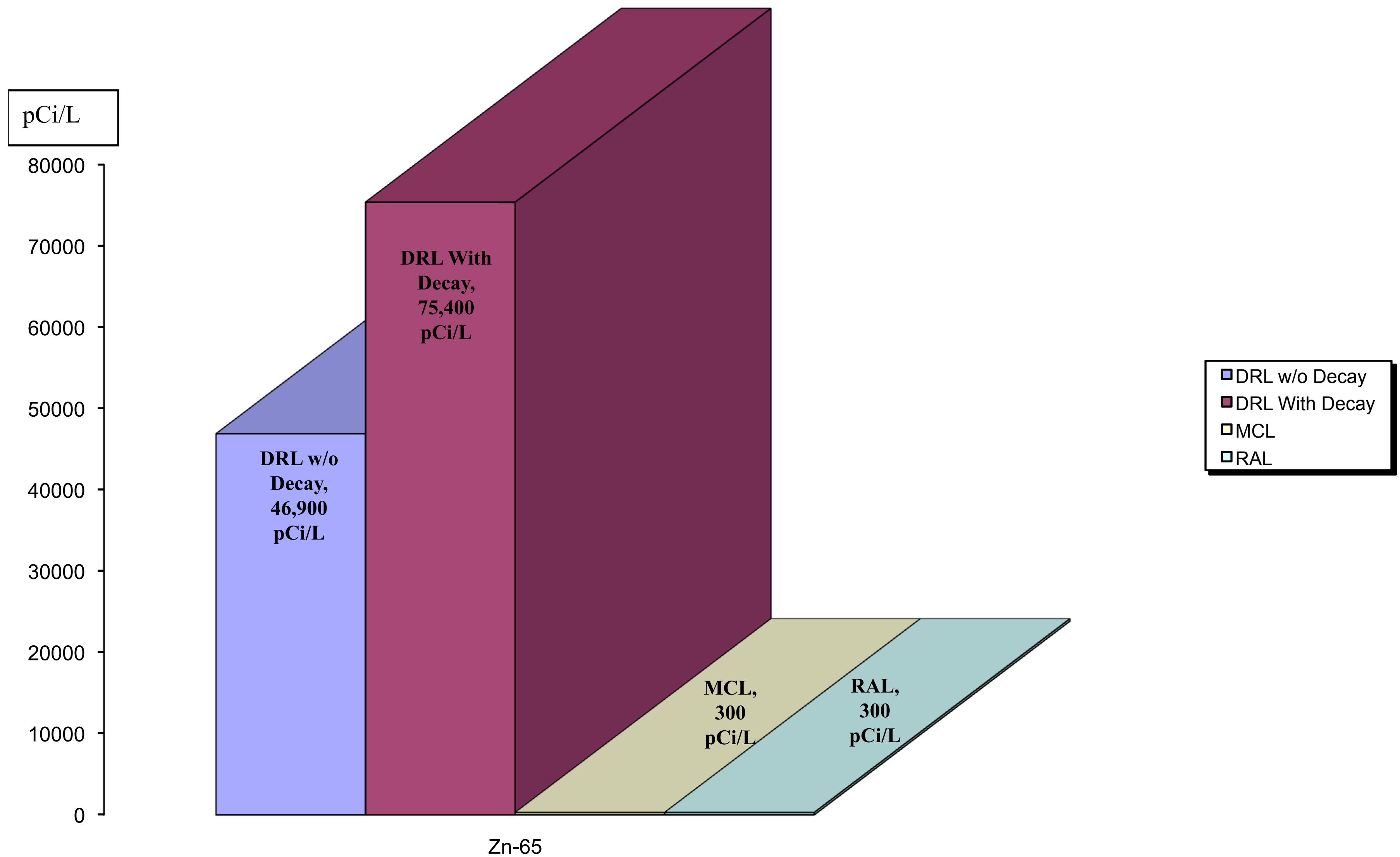


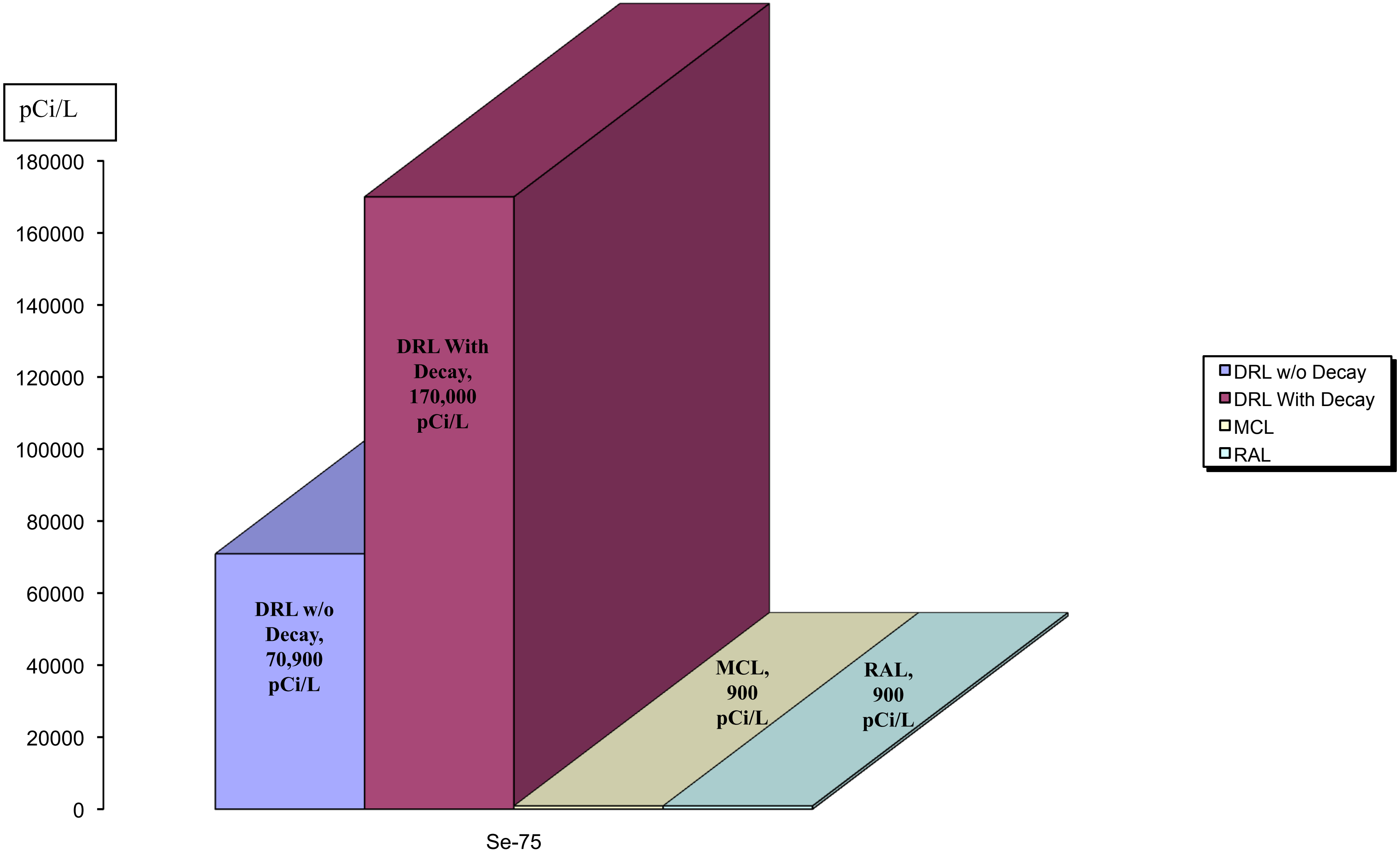
pCi/L
600000
500000
400000
300000
200000
100000
0
DRL With Decay, 591,000 pCi/L
DRL w/o Decay, 103,000 pCi/L
MCL, 200 pCi/L
RAL, 389.1 pCi/L
Fe-59
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 247,000 pCi/L
DRL With Decay, 909,000 pCi/L
MCL, 300 pCi/L
RAL, 1,013.5 pCi/L
Co-58
DRL w/o Decay
DRL With Decay
MCL
RAL

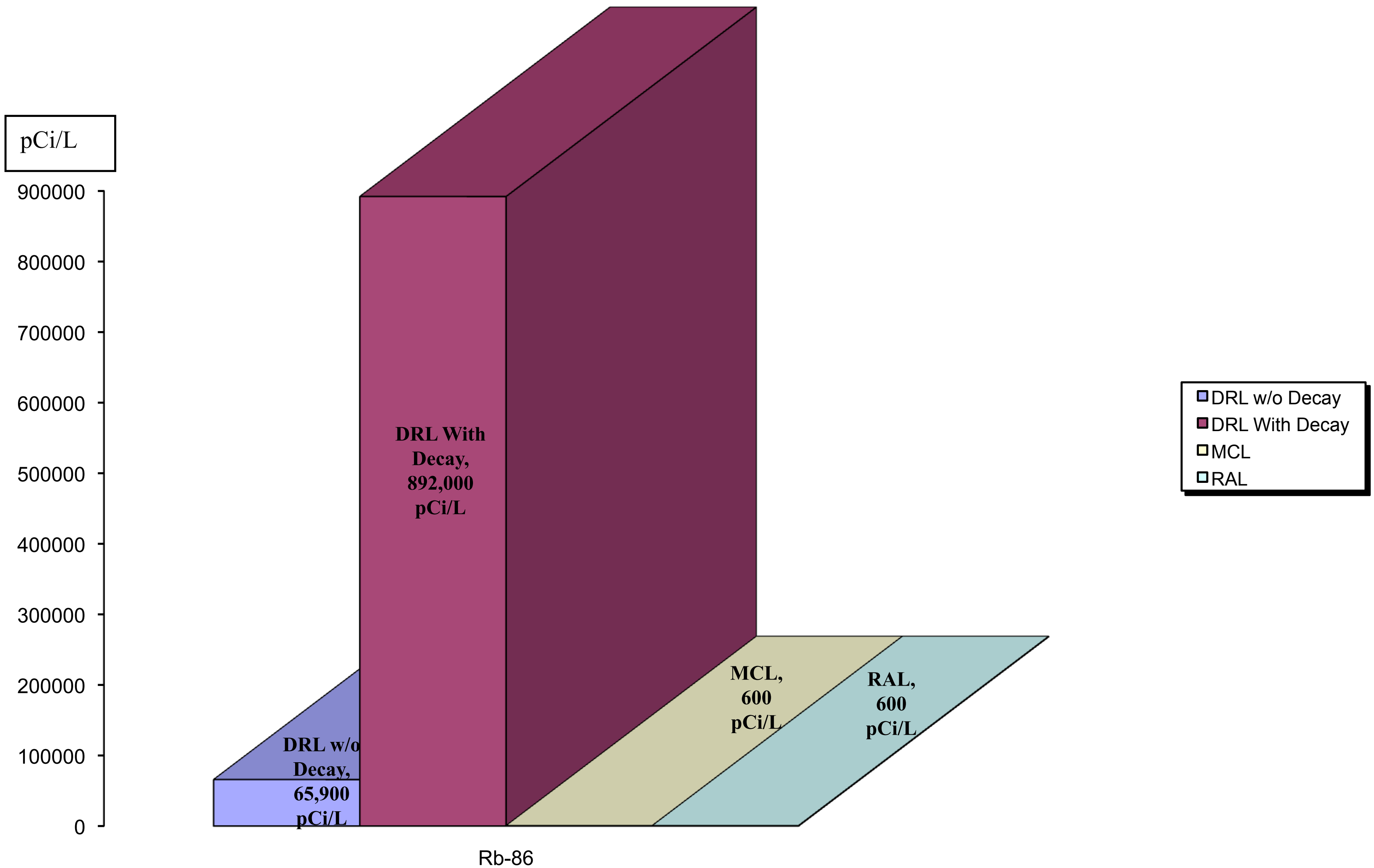

pCi/L
60000
50000
40000
30000
20000
10000
0
DRL w/o Decay, 53,900 pCi/L
DRL With Decay, 57,600 pCi/L
MCL, 100 pCi/L
RAL, 192.3 pCi/L
Co-60
DRL w/o Decay
DRL With Decay
MCL
RAL

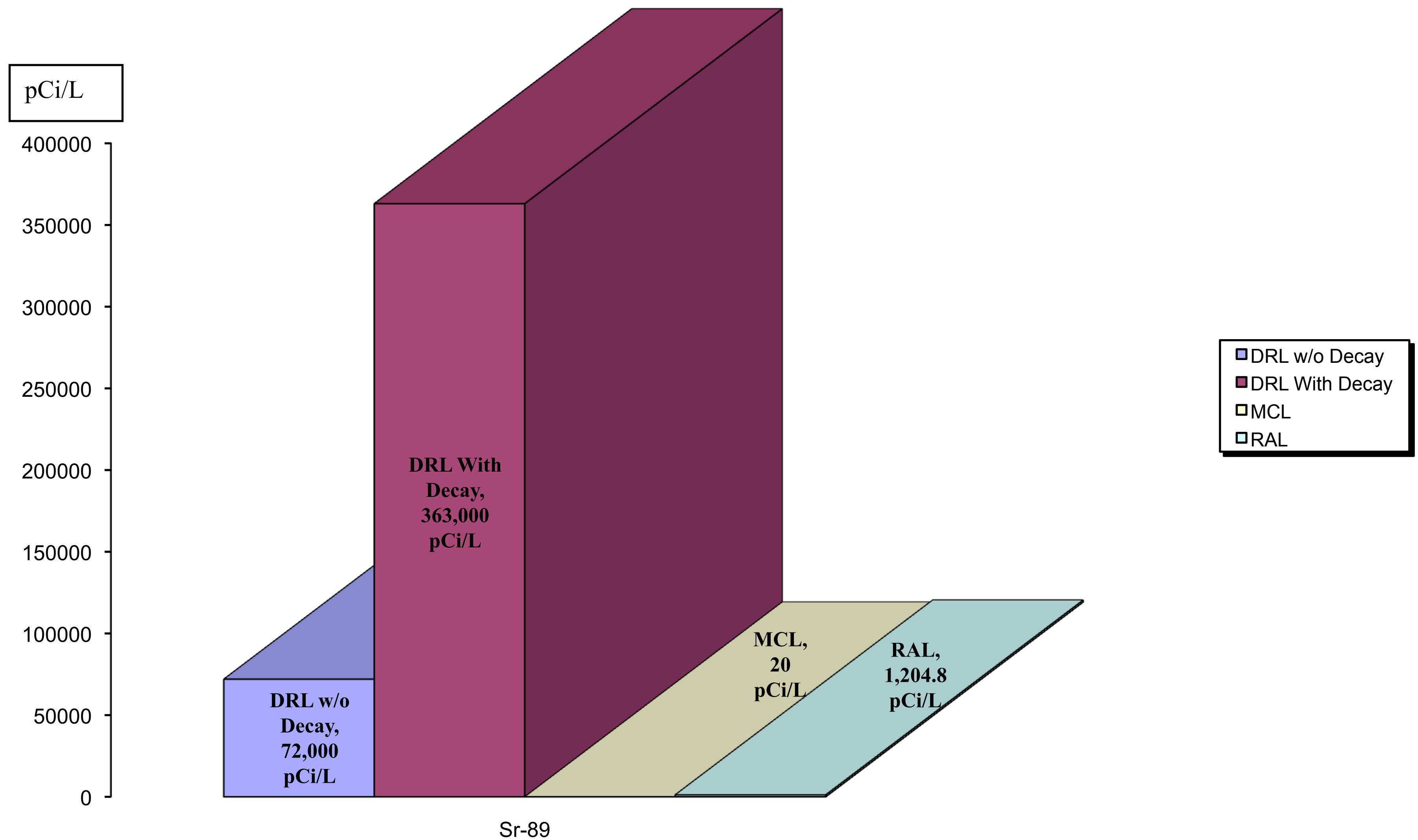

pCi/L
1400000
1200000
1000000
800000
600000
400000
200000
0
DRL w/o Decay, 1,220,000 pCi/L
DRL With Decay, 1,220,000 pCi/L
MCL, 50 pCi/L
RAL, 4,902 pCi/L
Ni-63
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
80000
70000
60000
50000
40000
30000
20000
10000
0
DRL w/o Decay, 46,900 pCi/L
DRL With Decay, 75,400 pCi/L
MCL, 300 pCi/L
RAL, 300 pCi/L
Zn-65
DRL w/o Decay
DRL With Decay
MCL
RAL

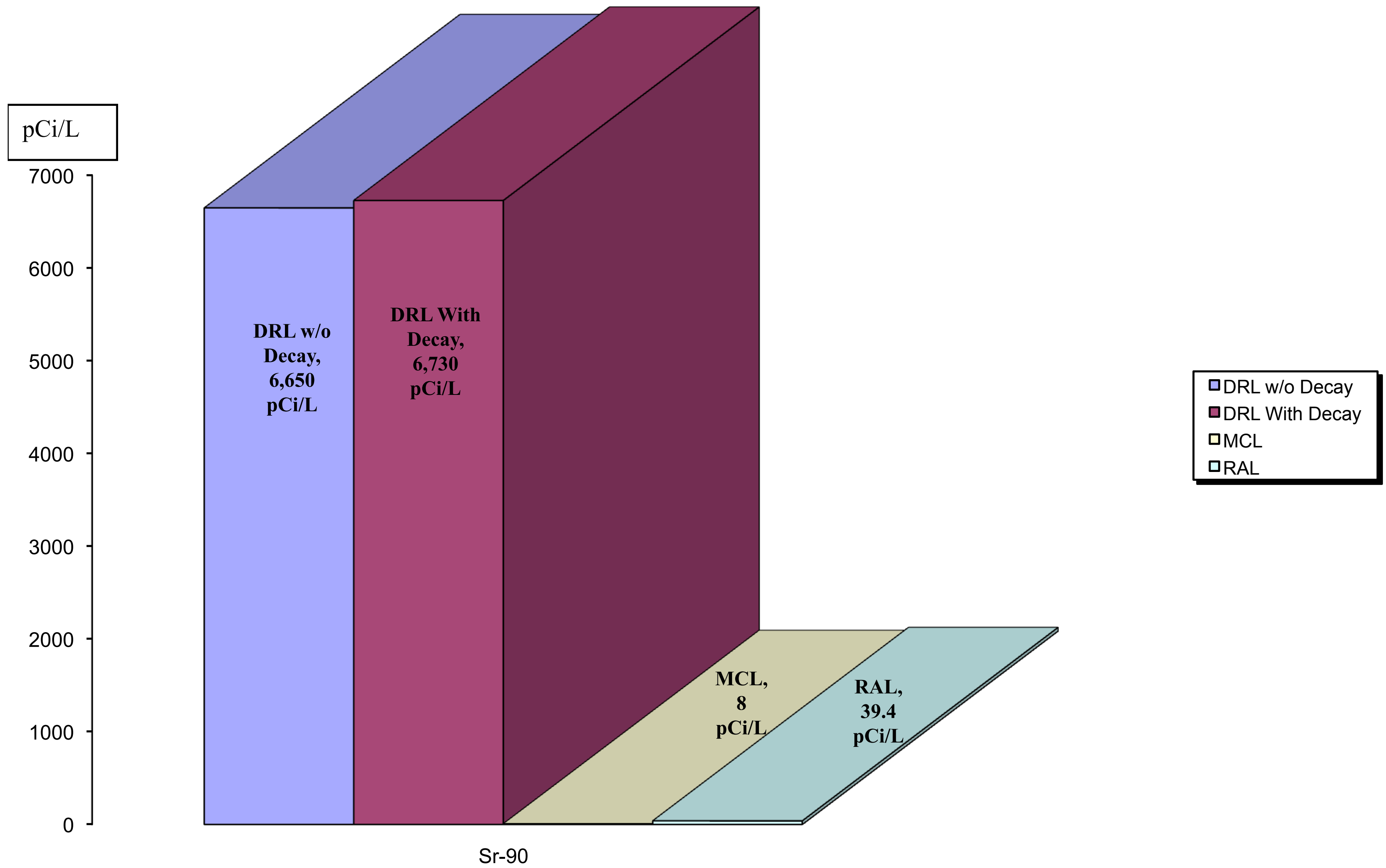


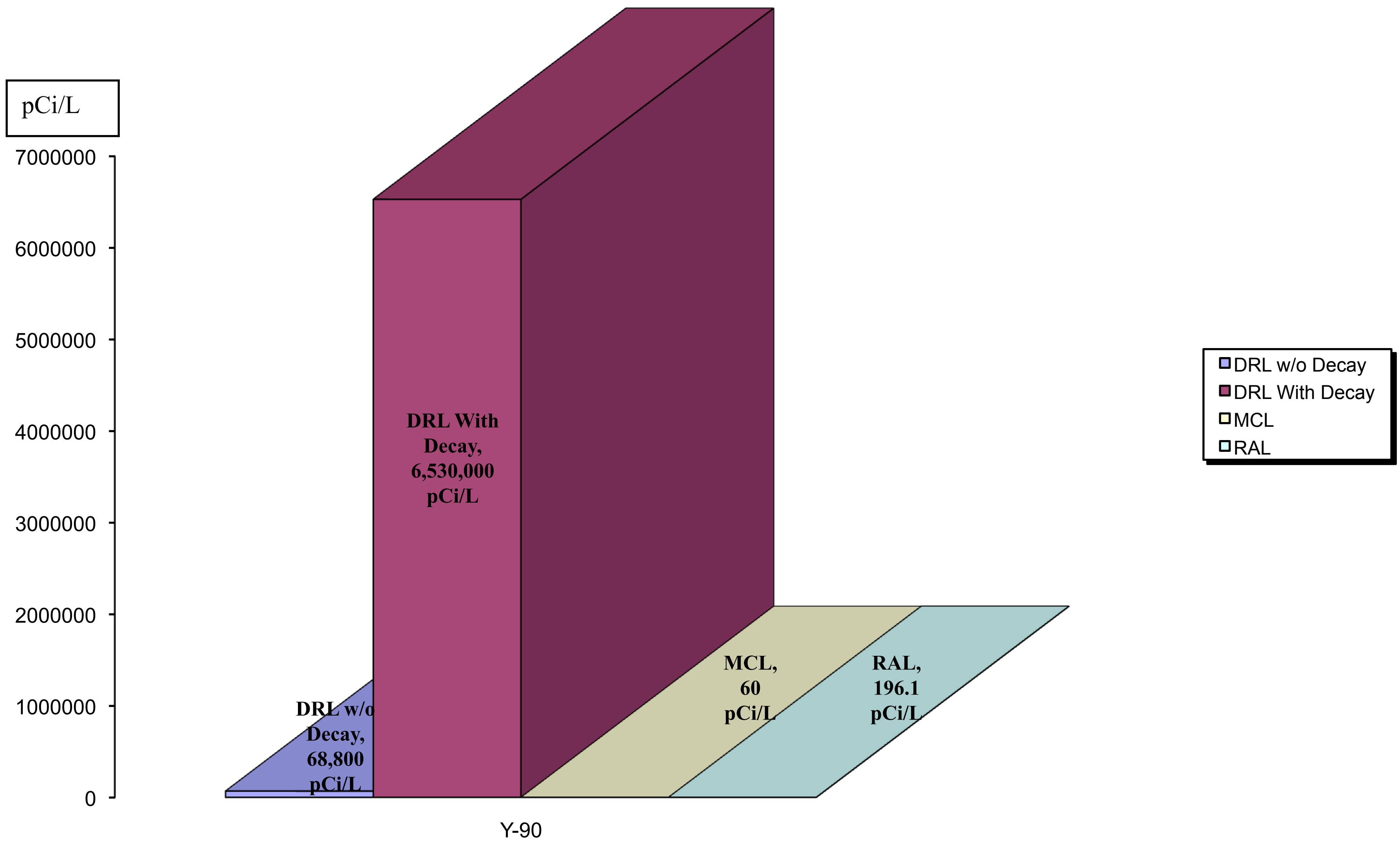
pCi/L
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
DRL w/o Decay, 70,900 pCi/L
DRL With Decay, 170,000 pCi/L
MCL, 900 pCi/L
RAL, 900 pCi/L
Se-75
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
DRL With Decay, 892,000 pCi/L
DRL w/o Decay, 65,900 pCi/L
MCL, 600 pCi/L
RAL, 600 pCi/L
Rb-86
DRL w/o Decay
DRL With Decay
MCL
RAL

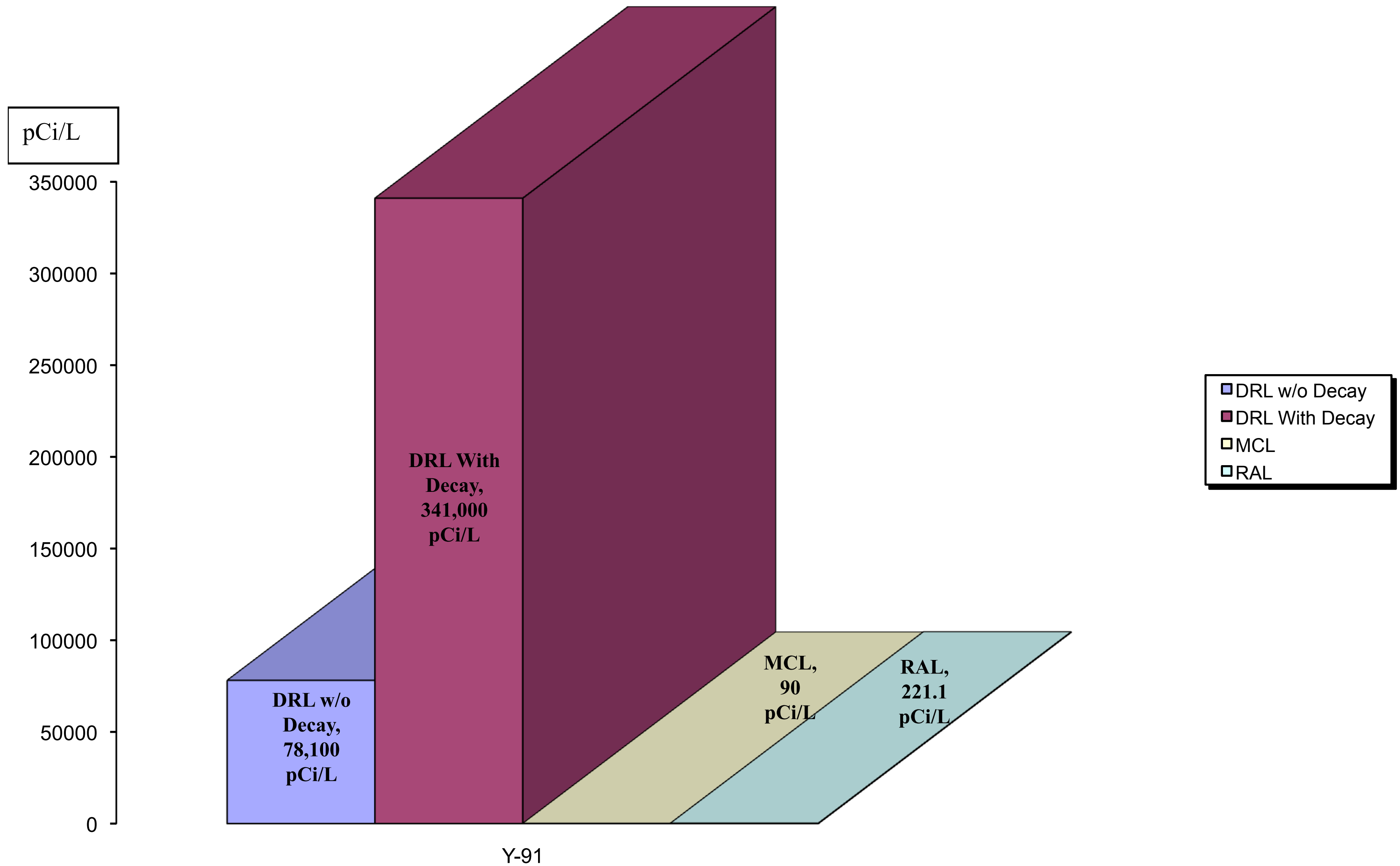


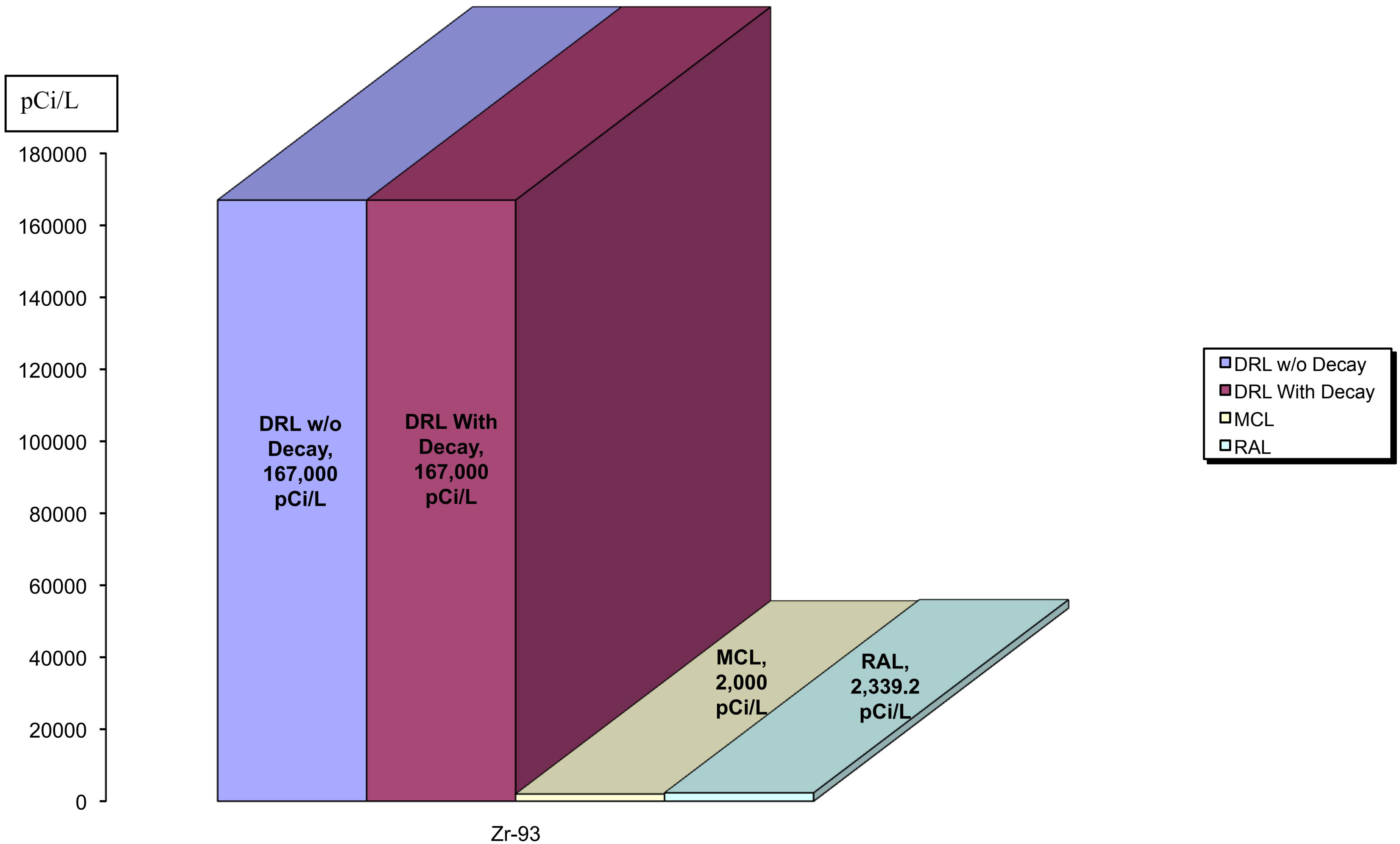
pCi/L
400000
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 72,000 pCi/L
DRL With Decay, 363,000 pCi/L
MCL, 20 pCi/L
RAL, 1,204.8 pCi/L
Sr-89
DRL w/o Decay
DRL With Decay
MCL
RAL

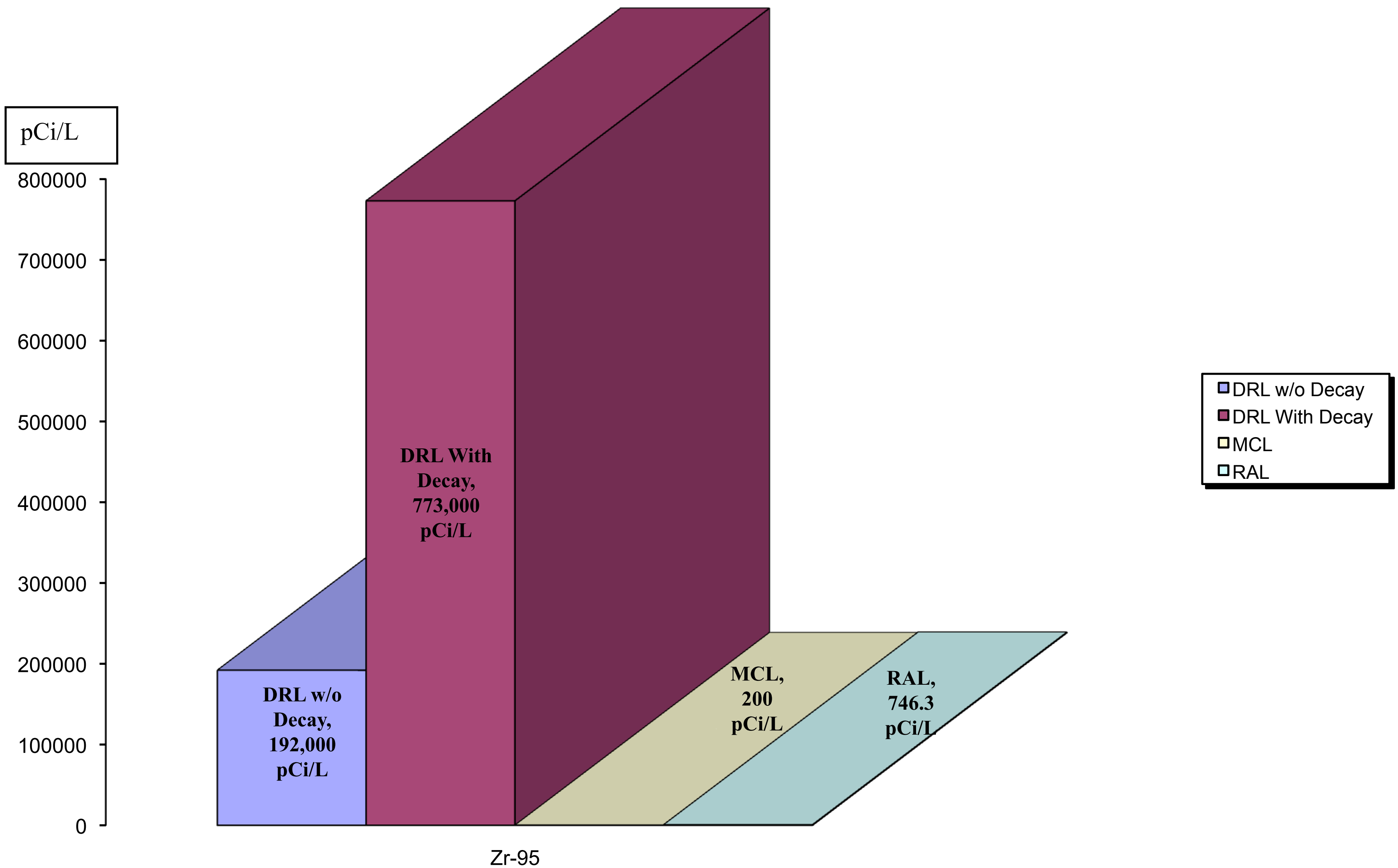

pCi/L
7000
6000
5000
4000
3000
2000
1000
0
DRL w/o Decay, 6,650 pCi/L
DRL With Decay, 6,730 pCi/L
MCL, 8 pCi/L
RAL, 39.4 pCi/L
Sr-90
DRL w/o Decay
DRL With Decay
MCL
RAL

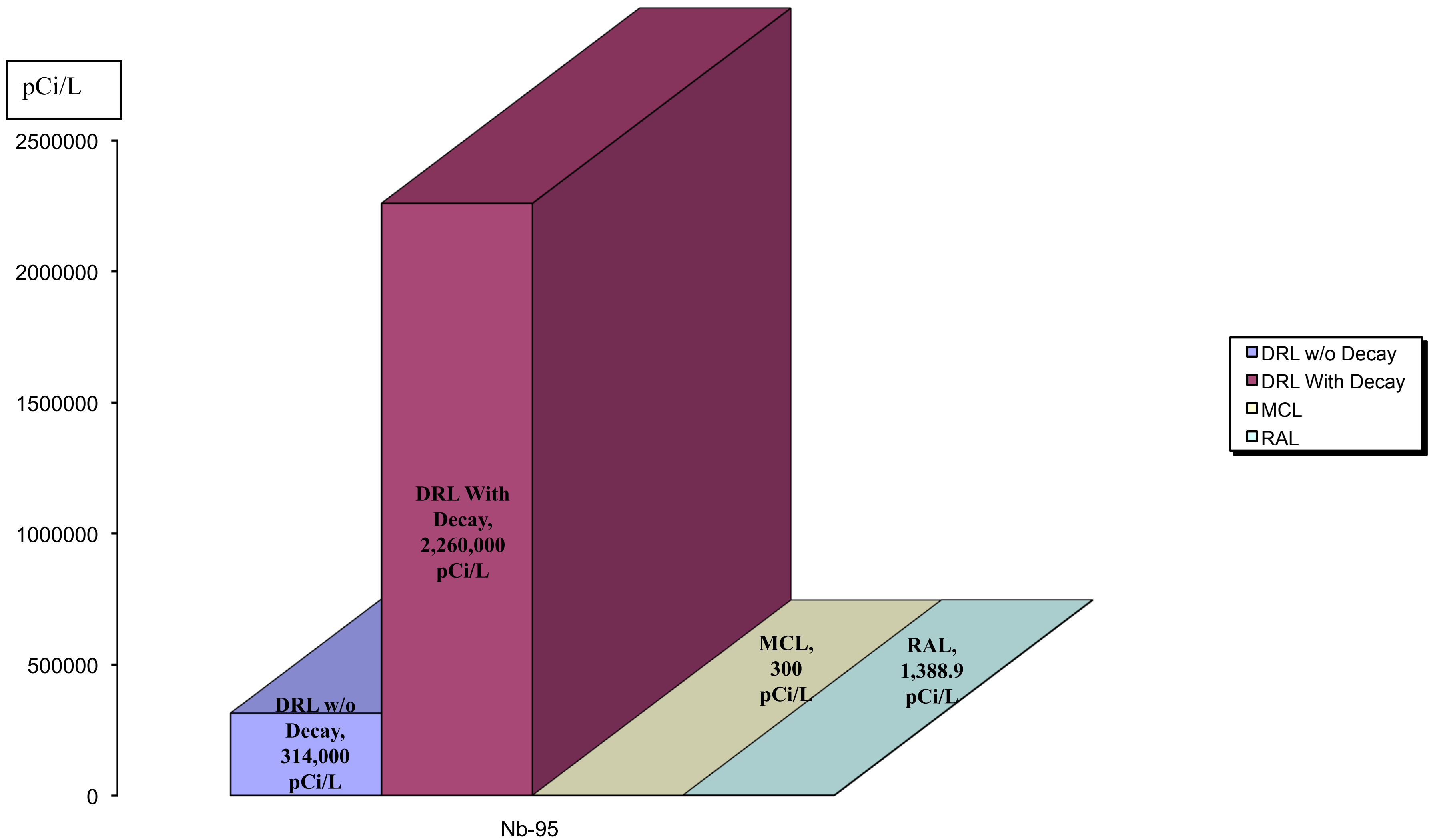


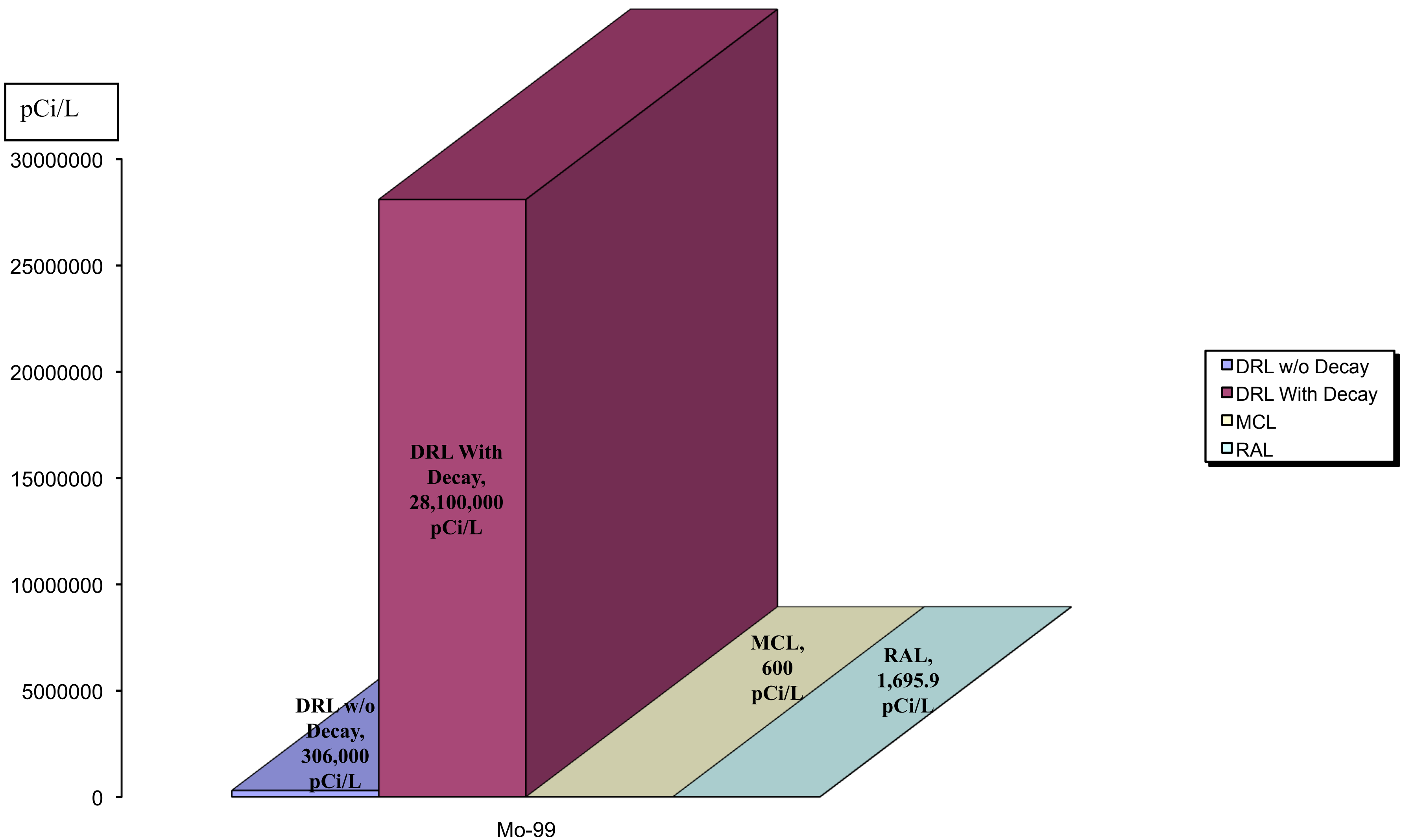
pCi/L
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
DRL With Decay, 6,530,000 pCi/L
DRL w/o Decay, 68,800 pCi/L
MCL, 60 pCi/L
RAL, 196.1 pCi/L
Y-90
DRL w/o Decay
DRL With Decay
MCL
RAL

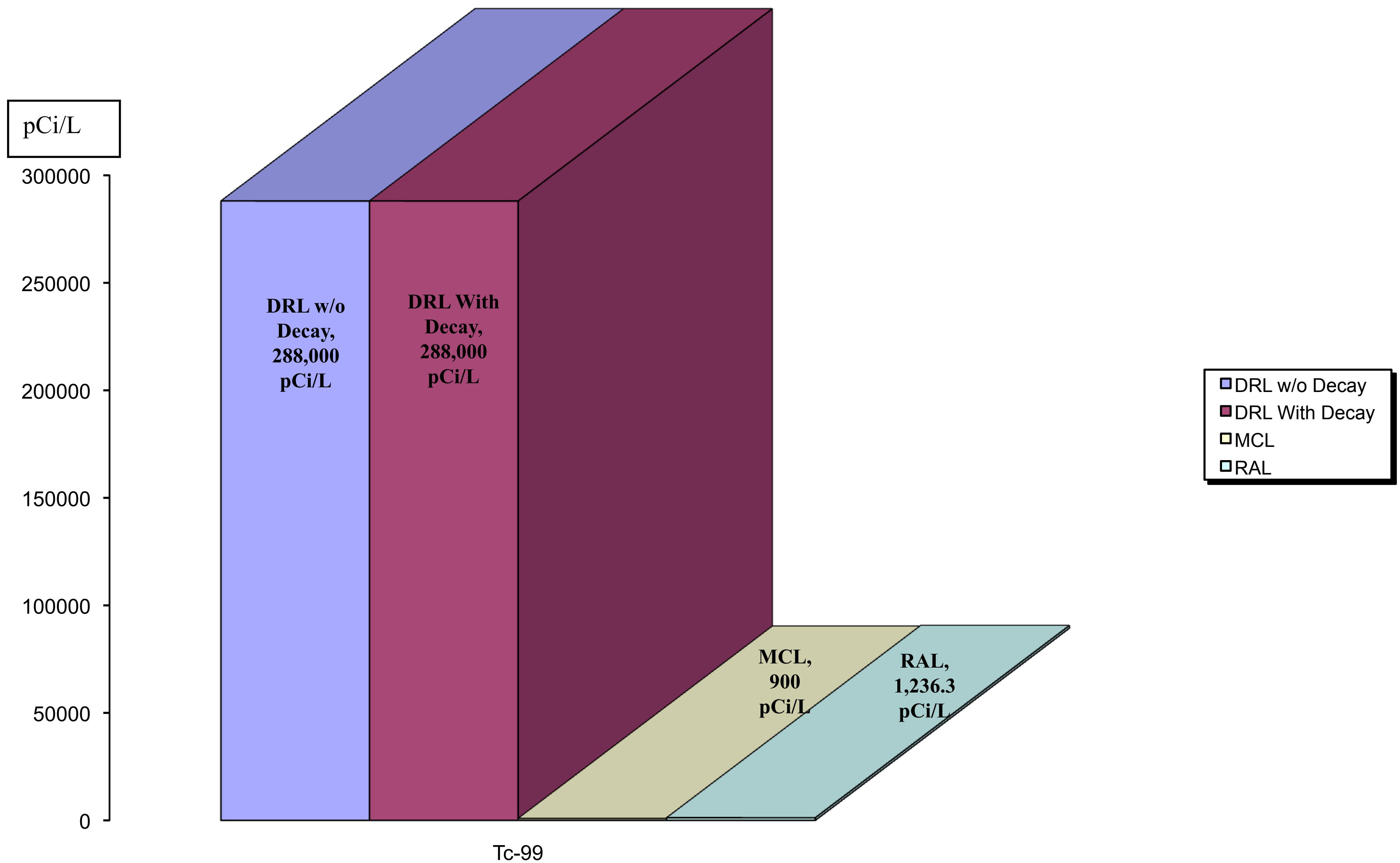

pCi/L
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 78,100 pCi/L
DRL With Decay, 341,000 pCi/L
MCL, 90 pCi/L
RAL, 221.1 pCi/L
Y-91
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
DRL w/o Decay, 167,000 pCi/L
DRL With Decay, 167,000 pCi/L
MCL, 2,000 pCi/L
RAL, 2,339.2 pCi/L
Zr-93
DRL w/o Decay
DRL With Decay
MCL
RAL

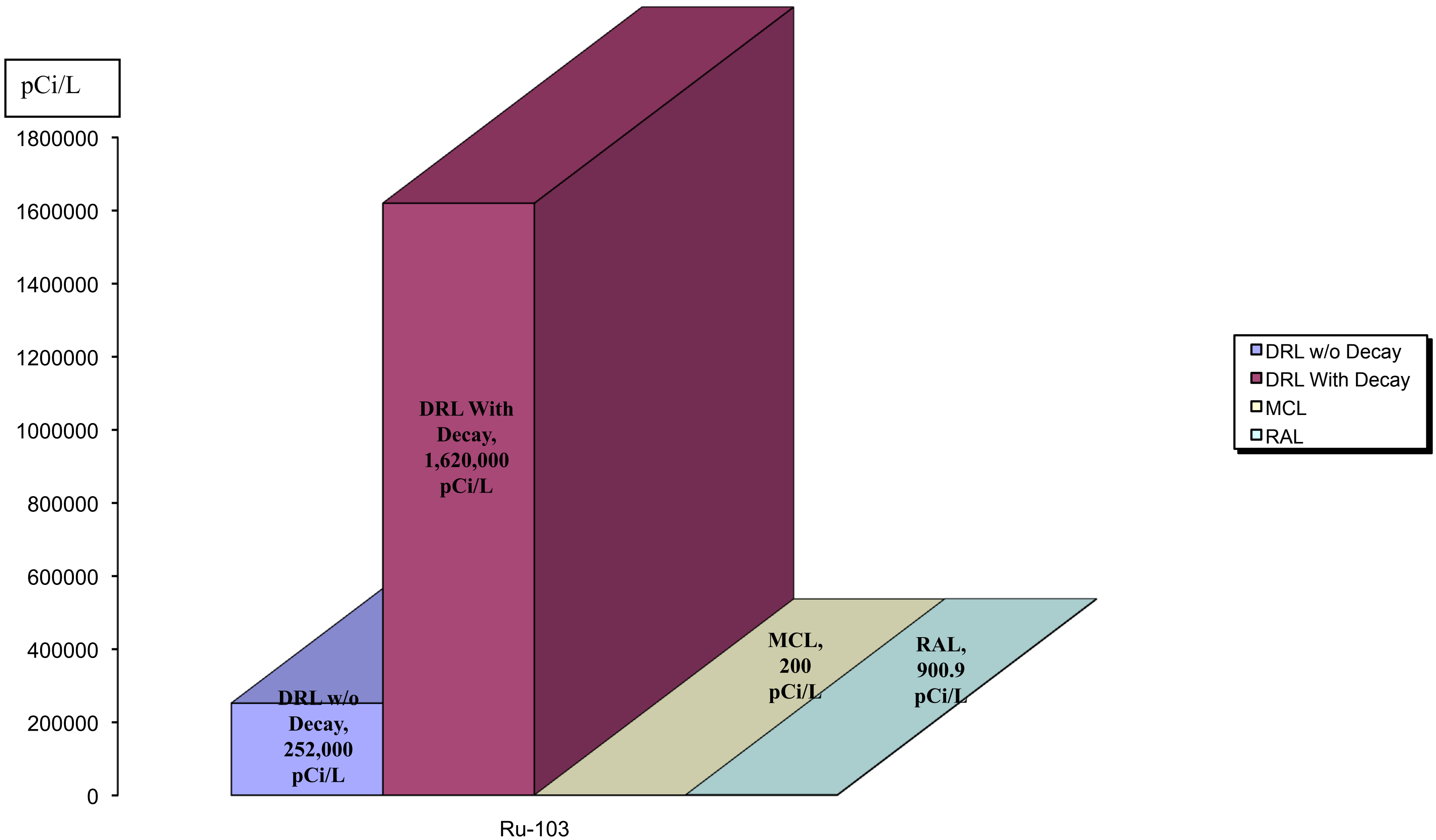

pCi/L
800000
700000
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 192,000 pCi/L
DRL With Decay, 773,000 pCi/L
MCL, 200 pCi/L
RAL, 746.3 pCi/L
Zr-95
DRL w/o Decay
DRL With Decay
MCL
RAL

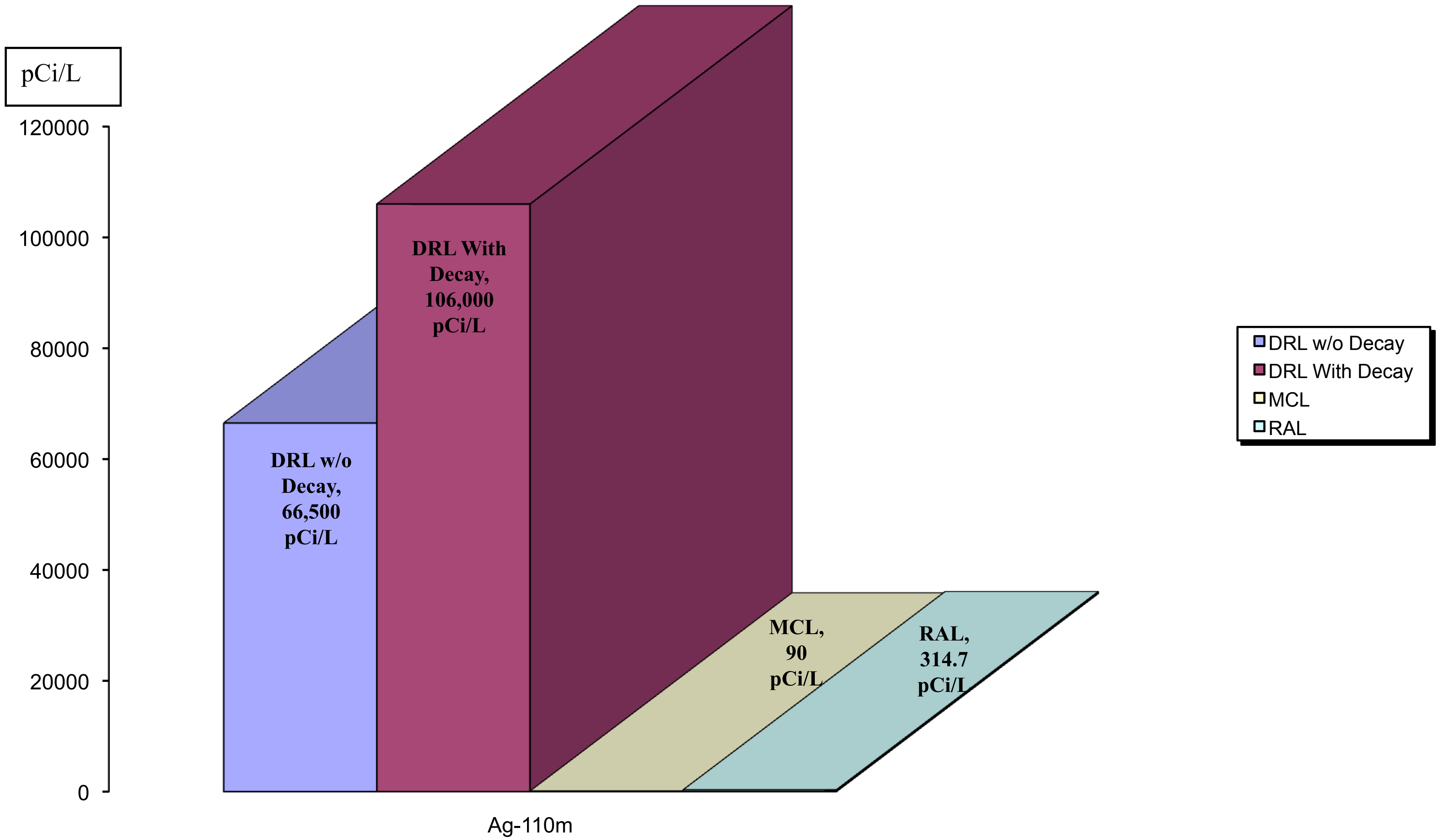

pCi/L
2500000
2000000
1500000
1000000
500000
0
DRL With Decay, 2,260,000 pCi/L
DRL w/o Decay, 314,000 pCi/L
MCL, 300 pCi/L
RAL, 1,388.9 pCi/L
Nb-95
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
30000000
25000000
20000000
15000000
10000000
5000000
0
DRL w/o Decay, 306,000 pCi/L
DRL With Decay, 28,100,000 pCi/L
MCL, 600 pCi/L
RAL, 1,695.9 pCi/L
Mo-99
DRL w/o Decay
DRL With Decay
MCL
RAL

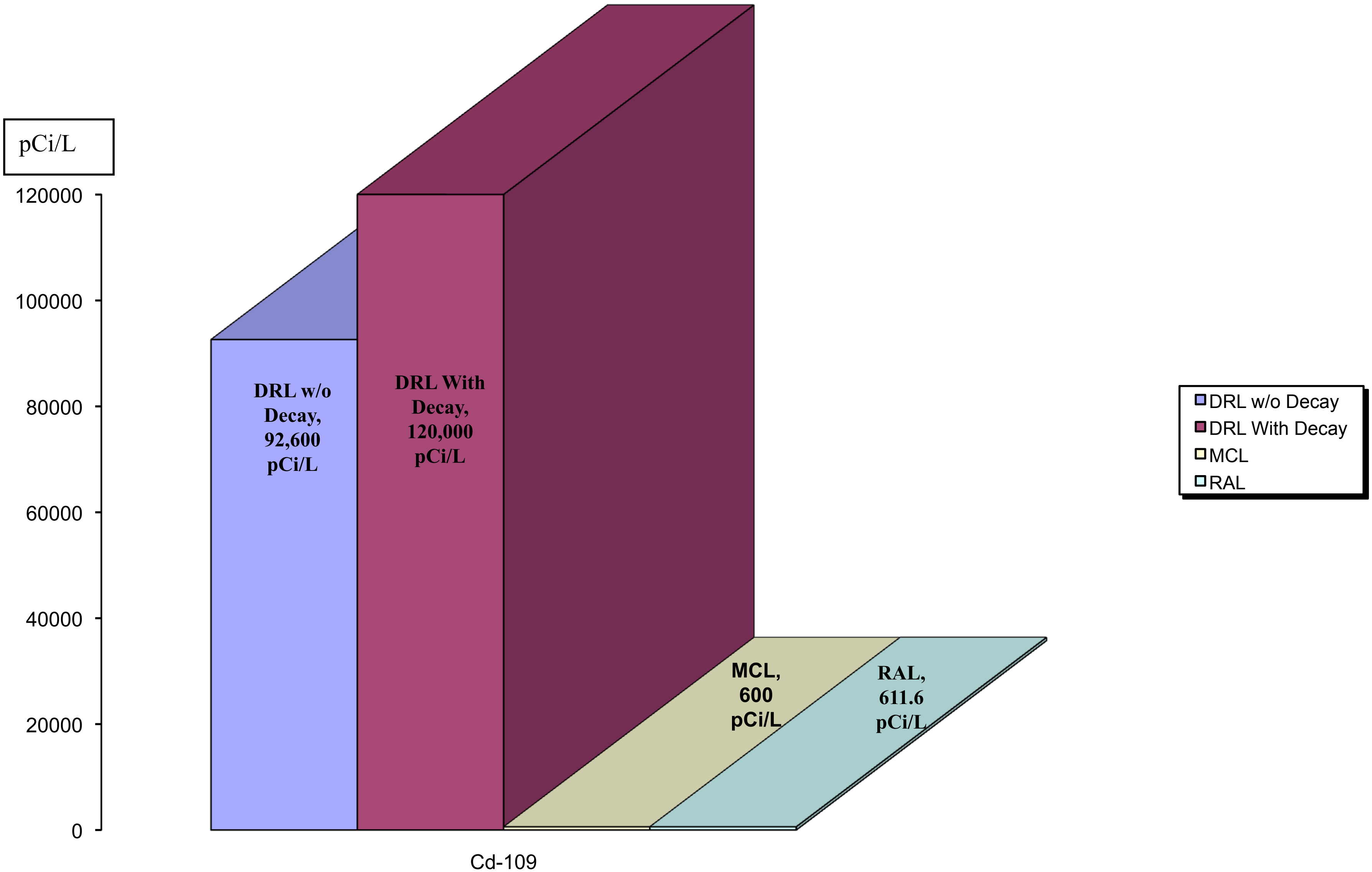


pCi/L
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 288,000 pCi/L
DRL With Decay, 288,000 pCi/L
MCL, 900 pCi/L
RAL, 1,236.3 pCi/L
Tc-99
DRL w/o Decay
DRL With Decay
MCL
RAL

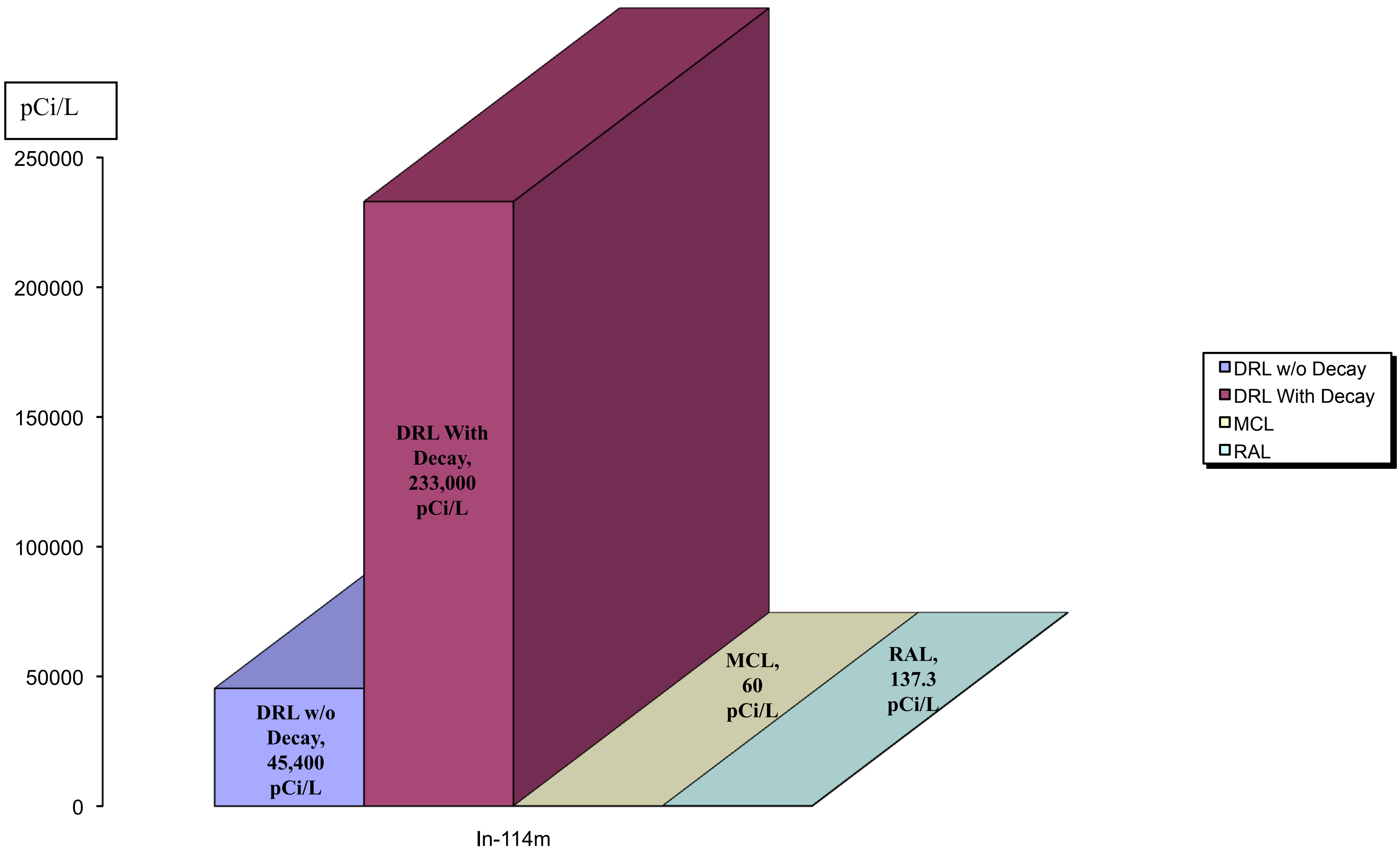

pCi/L
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
DRL w/o Decay, 252,000 pCi/L
DRL With Decay, 1,620,000 pCi/L
MCL, 200 pCi/L
RAL, 900.9 pCi/L
Ru-103
DRL w/o Decay
DRL With Decay
MCL
RAL



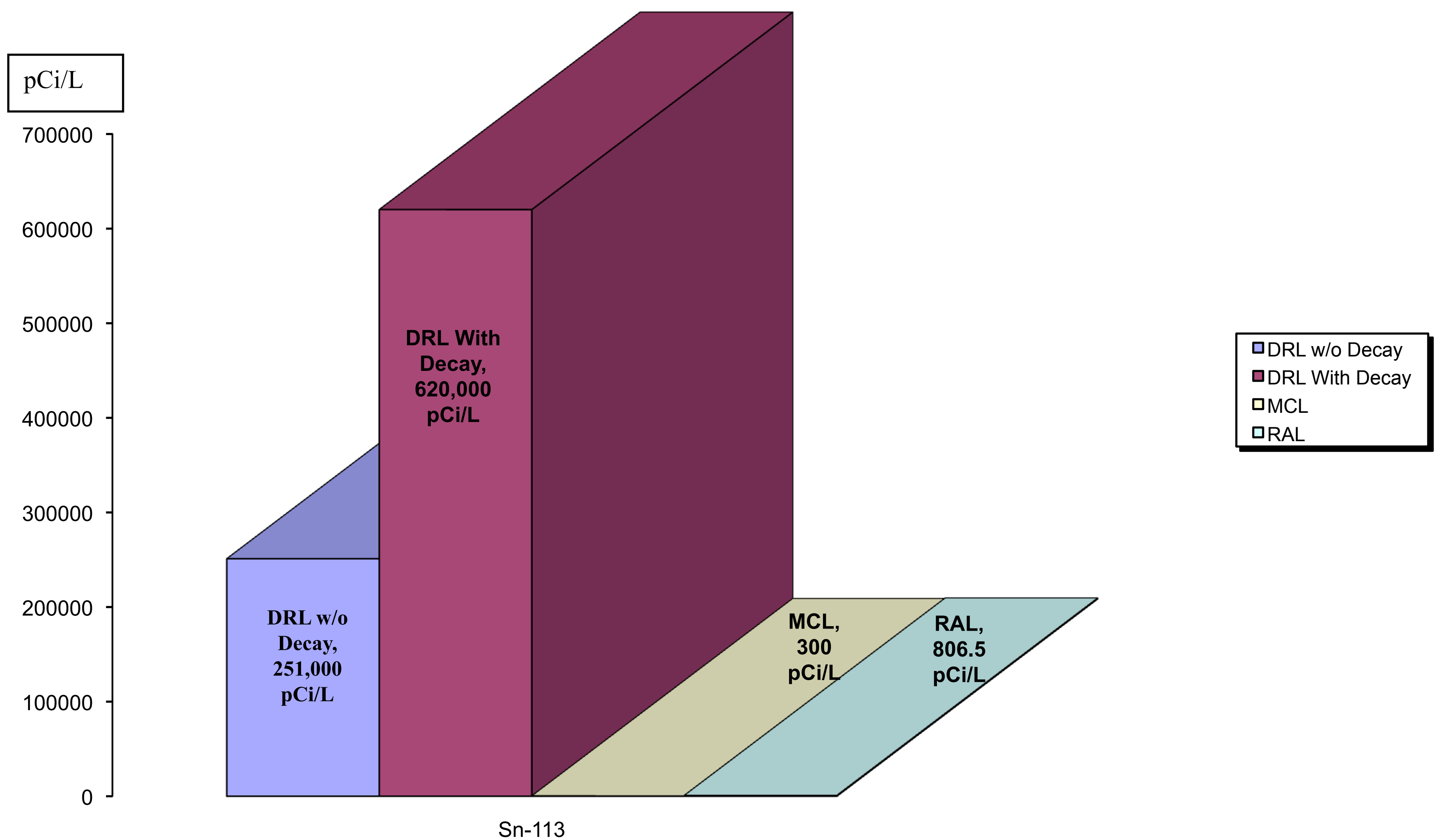
pCi/L
120000
100000
80000
60000
40000
20000
0
DRL w/o Decay, 66,500 pCi/L
DRL With Decay, 106,000 pCi/L
MCL, 90 pCi/L
RAL, 314.7 pCi/L
Ag-110m
DRL w/o Decay
DRL With Decay
MCL
RAL

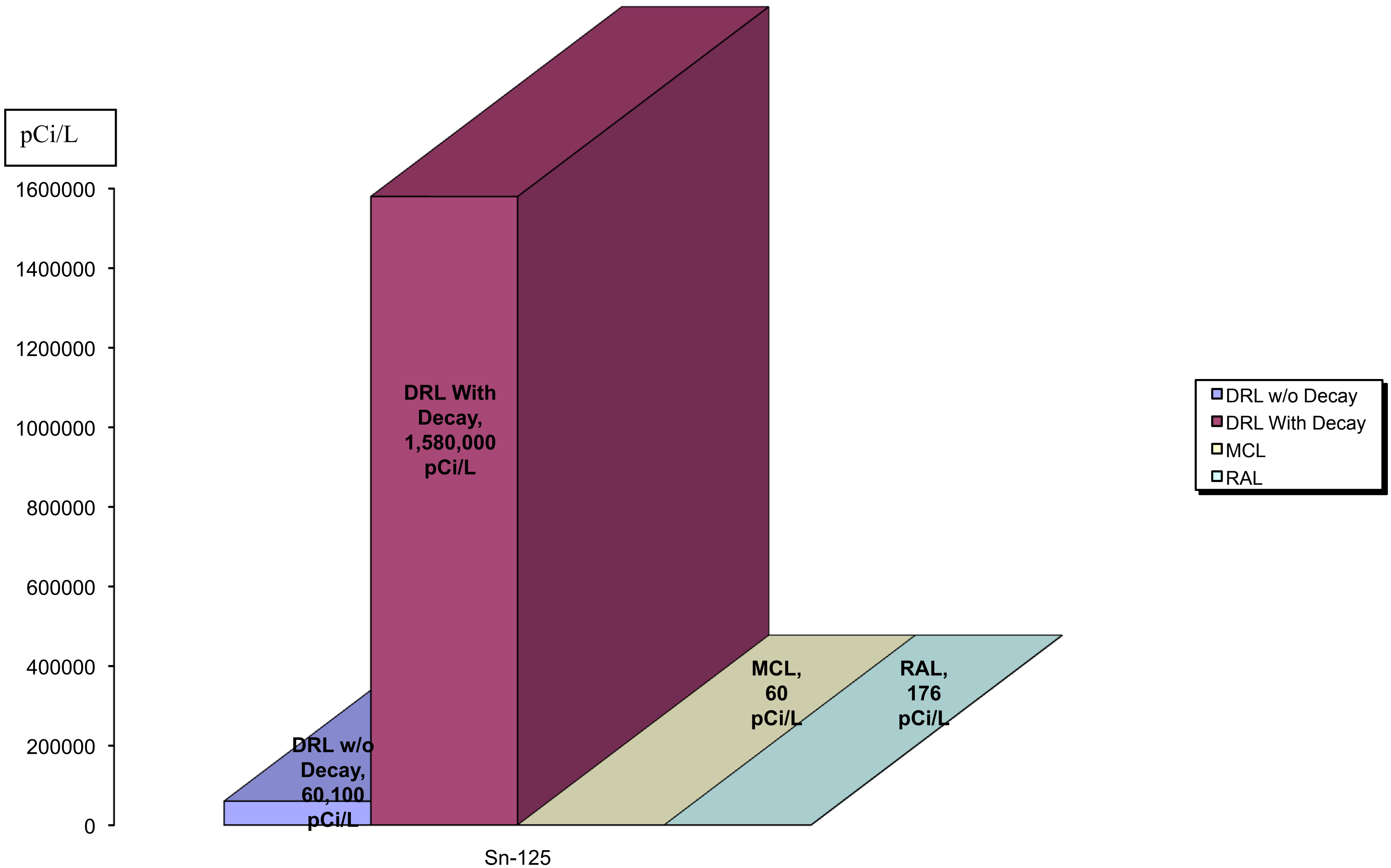


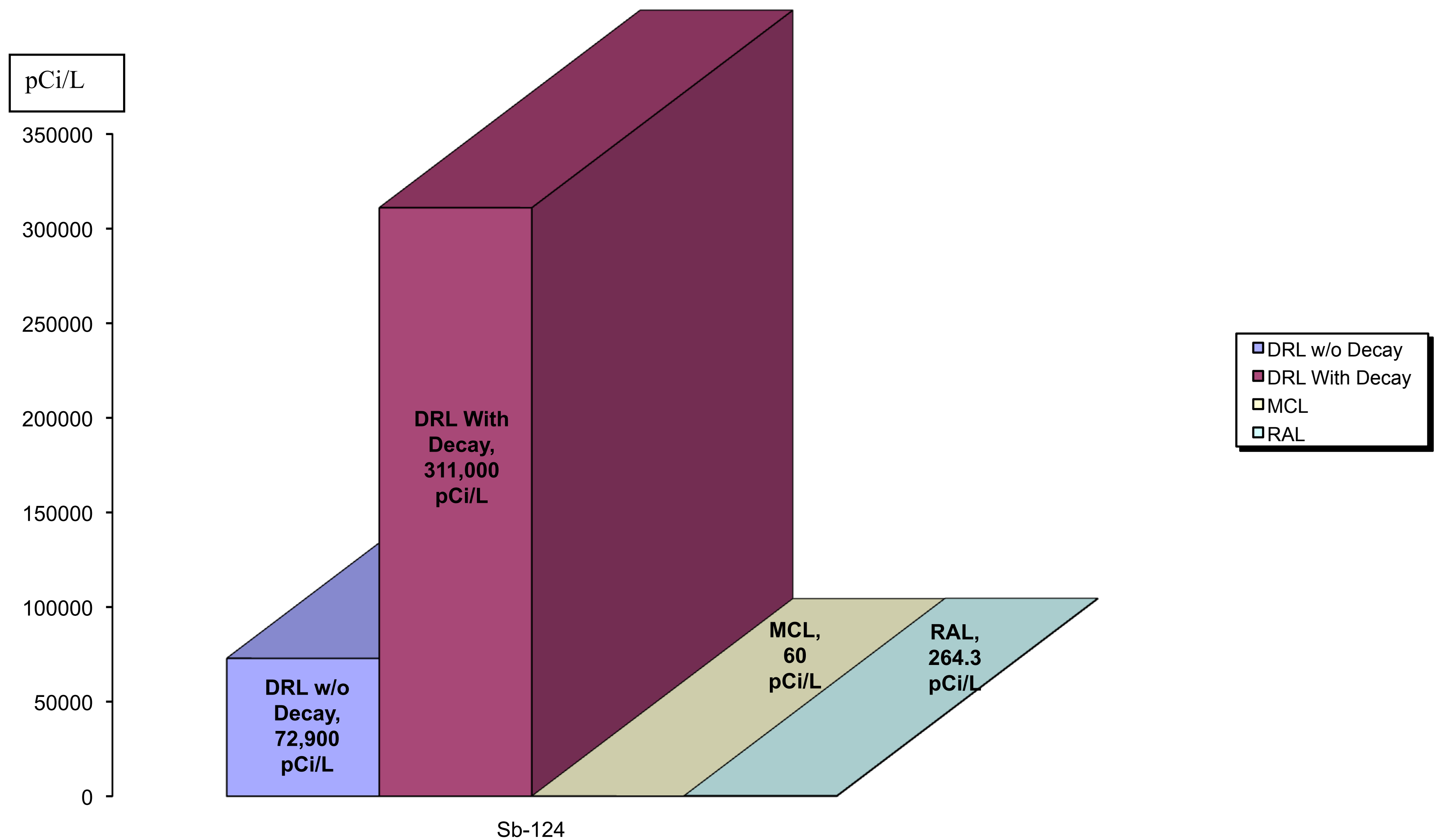
pCi/L
120000
100000
80000
60000
40000
20000
0
DRL w/o Decay, 92,600 pCi/L
DRL With Decay, 120,000 pCi/L
MCL, 600 pCi/L
RAL, 611.6 pCi/L
Cd-109
DRL w/o Decay
DRL With Decay
MCL
RAL

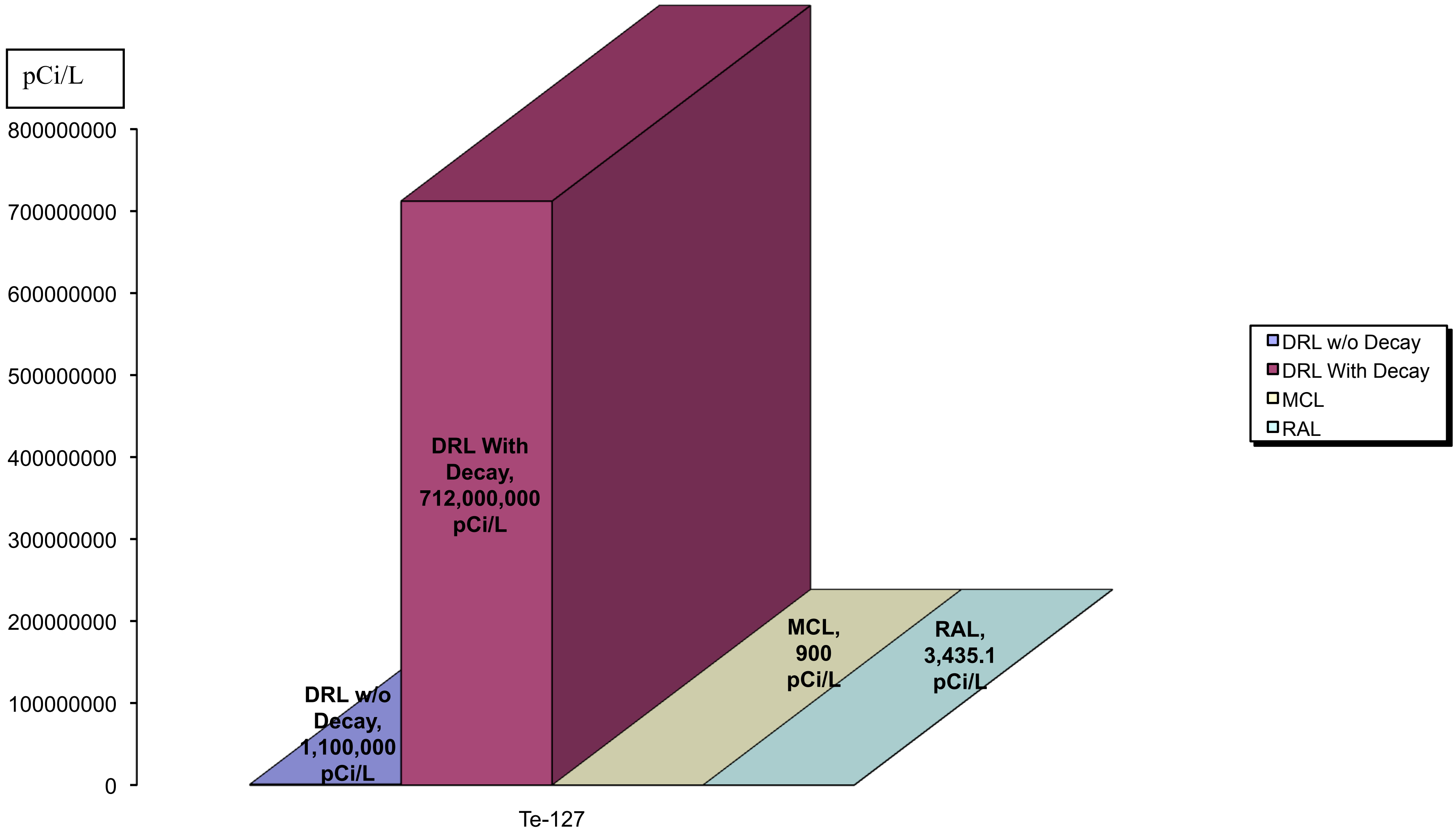


pCi/L
250000
200000
150000
100000
50000
0
DRL w/o Decay, 45,400 pCi/L
DRL With Decay, 233,000 pCi/L
MCL, 60 pCi/L
RAL, 137.3 pCi/L
In-114m
DRL w/o Decay
DRL With Decay
MCL
RAL

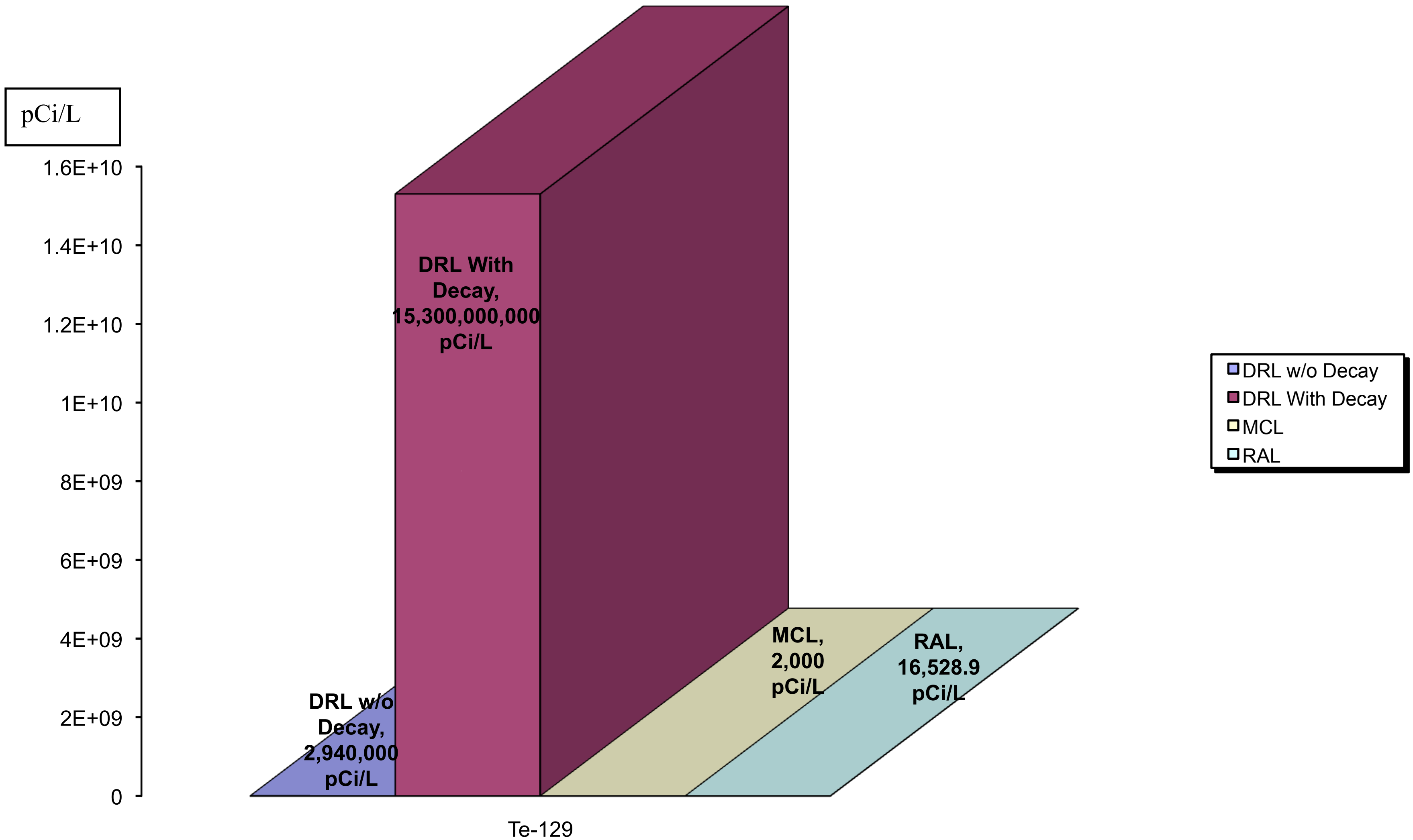

pCi/L
700000
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 251,000 pCi/L
DRL With Decay, 620,000 pCi/L
MCL, 300 pCi/L
RAL, 806.5 pCi/L
Sn-113
DRL w/o Decay
DRL With Decay
MCL
RAL

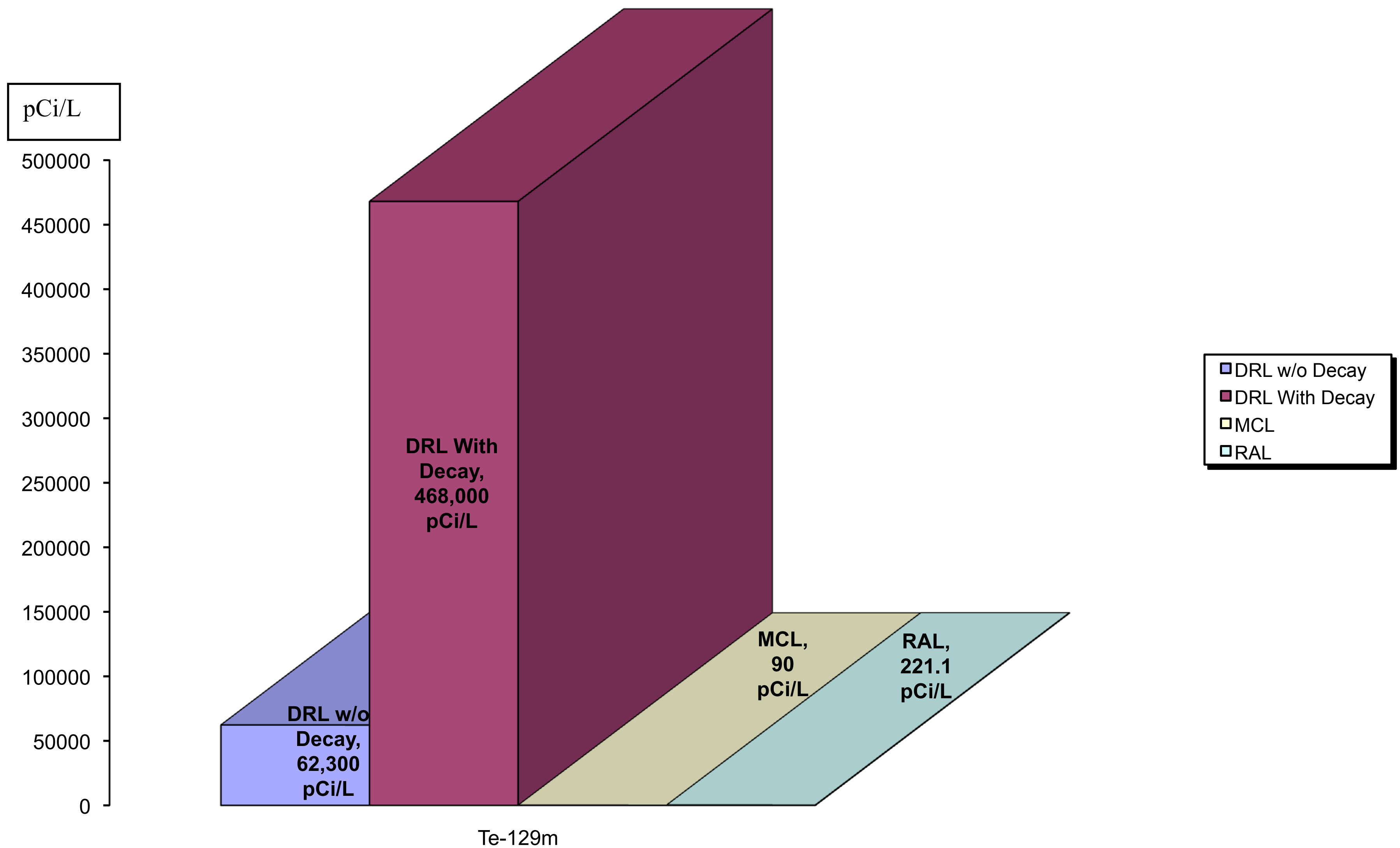

pCi/L
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
DRL With Decay, 1,580,000 pCi/L
DRL w/o Decay, 60,100 pCi/L
MCL, 60 pCi/L
RAL, 176 pCi/L
Sn-125
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 72,900 pCi/L
DRL With Decay, 311,000 pCi/L
MCL, 60 pCi/L
RAL, 264.3 pCi/L
Sb-124
DRL w/o Decay
DRL With Decay
MCL
RAL

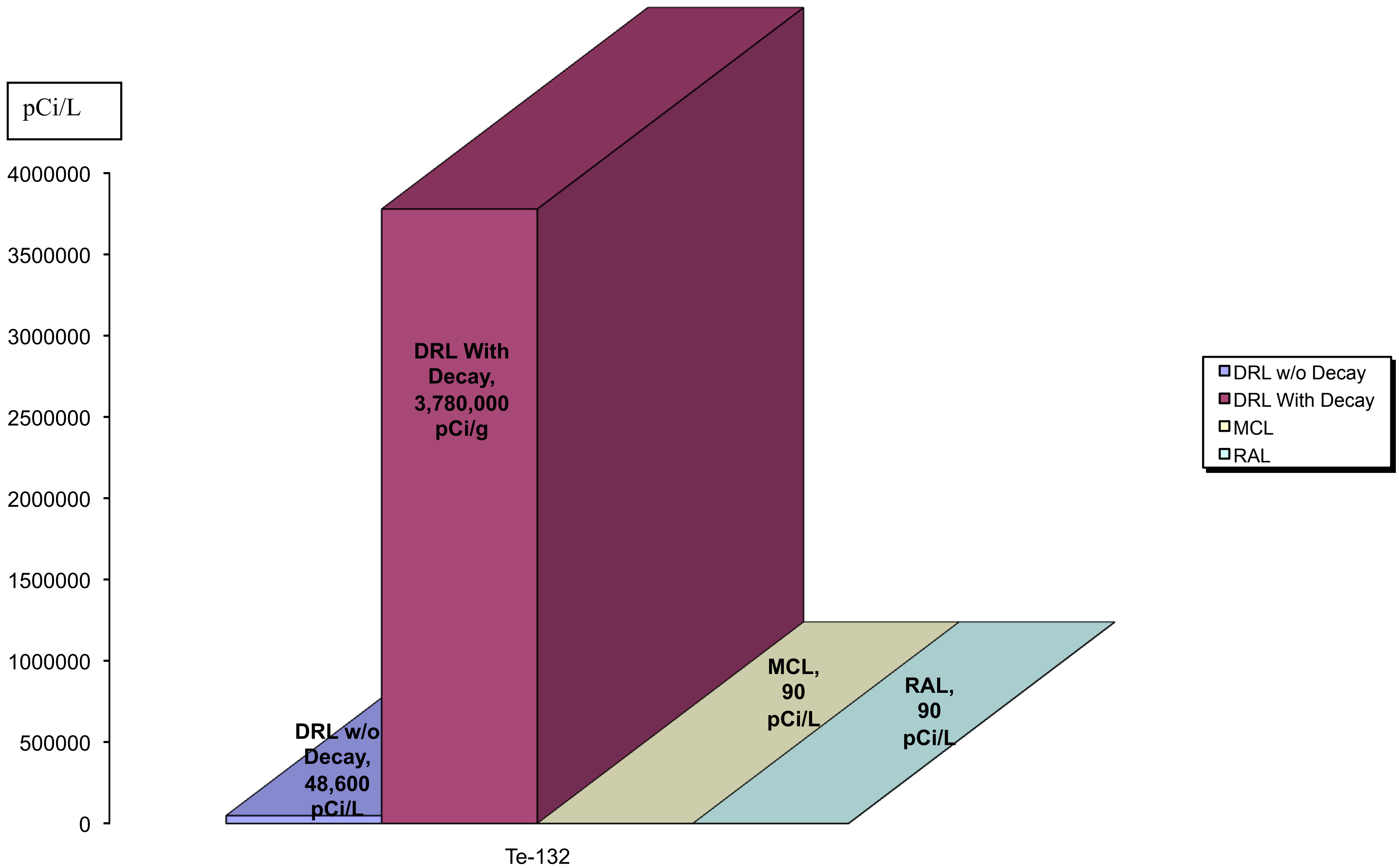


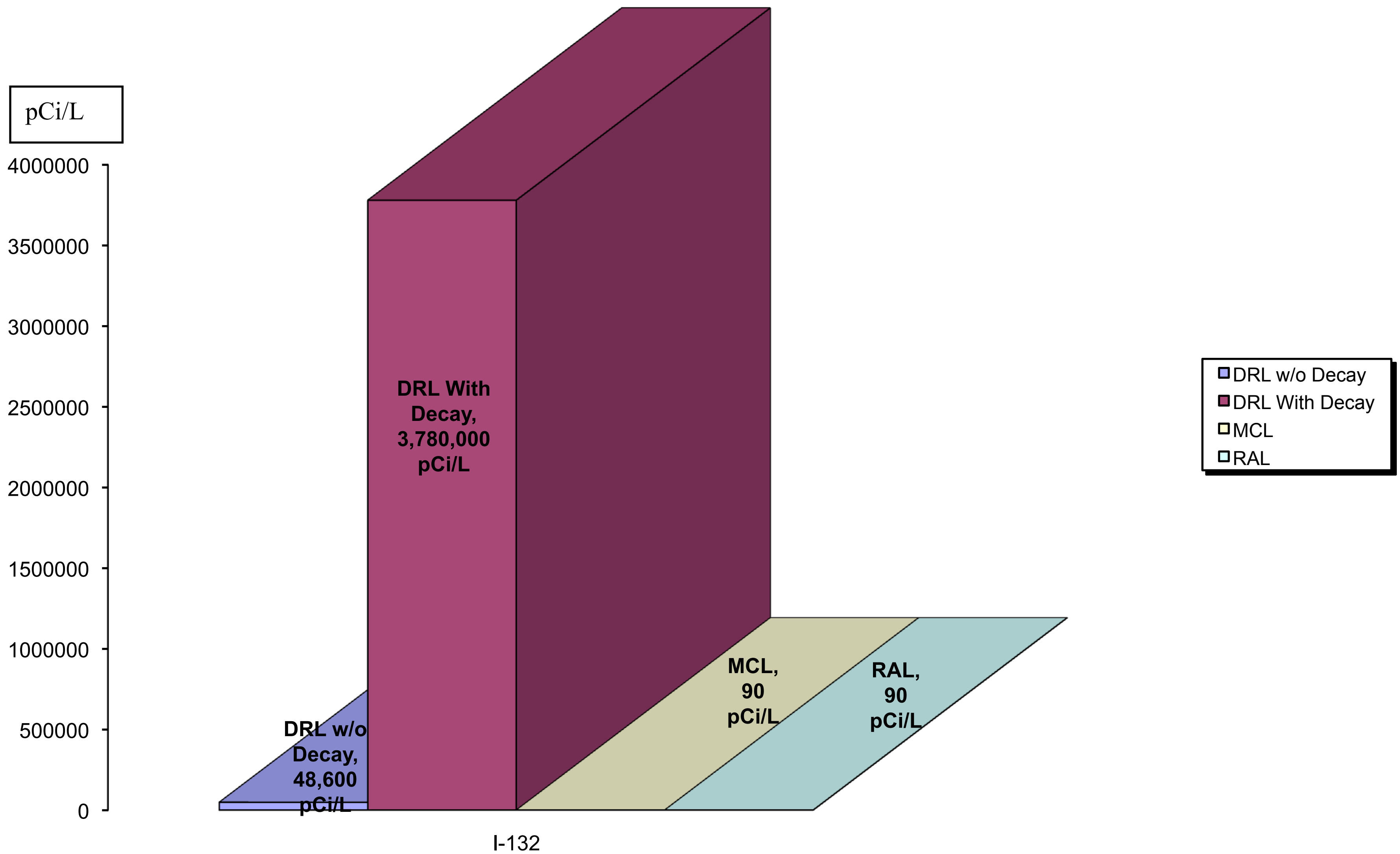
pCi/L
800000000
700000000
600000000
500000000
400000000
300000000
200000000
100000000
0
DRL With Decay, 712,000,000 pCi/L
DRL w/o Decay, 1,100,000 pCi/L
MCL, 900 pCi/L
RAL, 3,435.1 pCi/L
Te-127
DRL w/o Decay
DRL With Decay
MCL
RAL

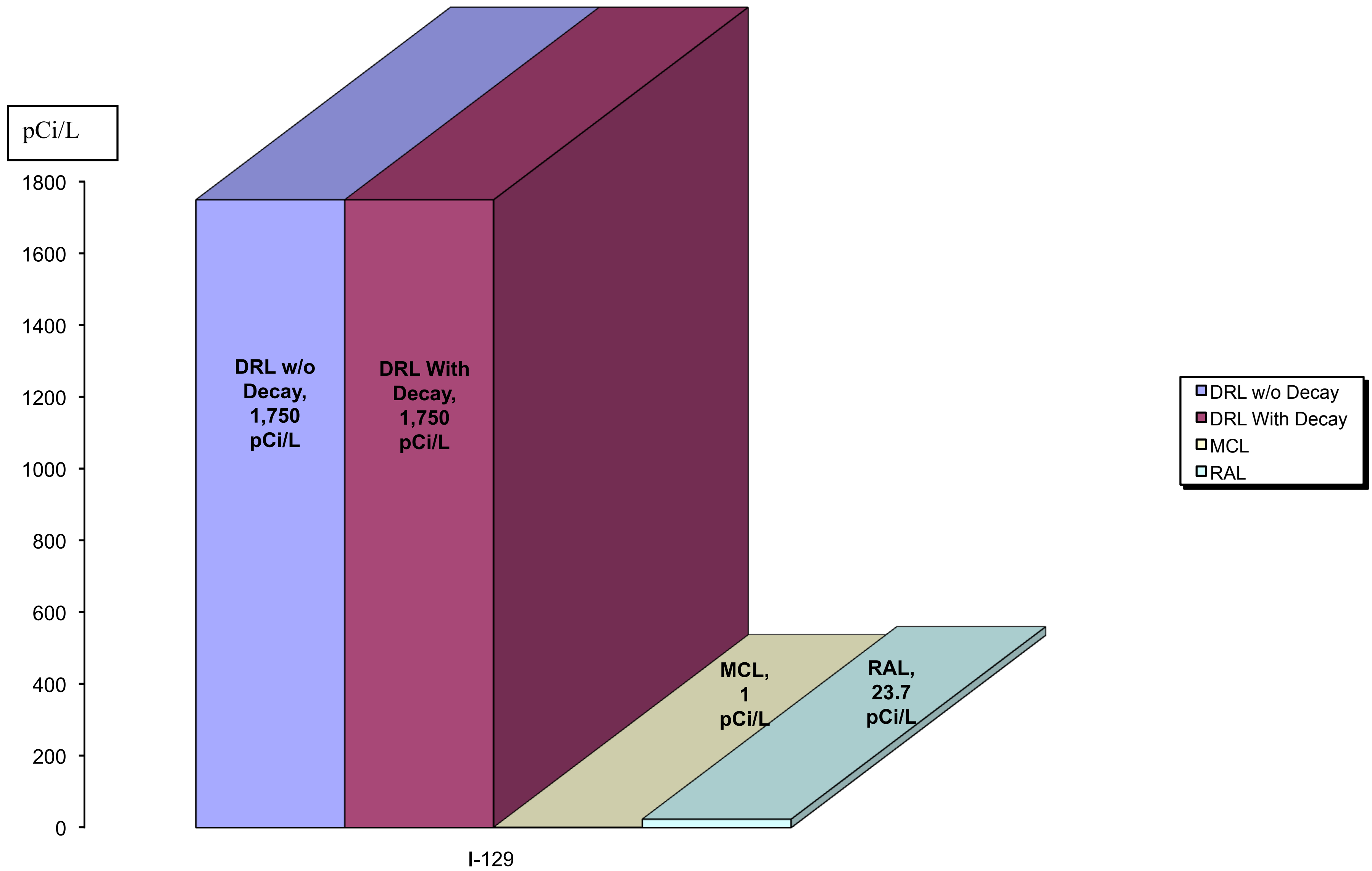

pCi/L
1.6E+10
1.4E+10
1.2E+10
1E+10
8E+09
6E+09
4E+09
2E+09
0
DRL With Decay, 15,300,000,000 pCi/L
DRL w/o Decay, 2,940,000 pCi/L
MCL, 2,000 pCi/L
RAL, 16,528.9 pCi/L
Te-129
DRL w/o Decay
DRL With Decay
MCL
RAL

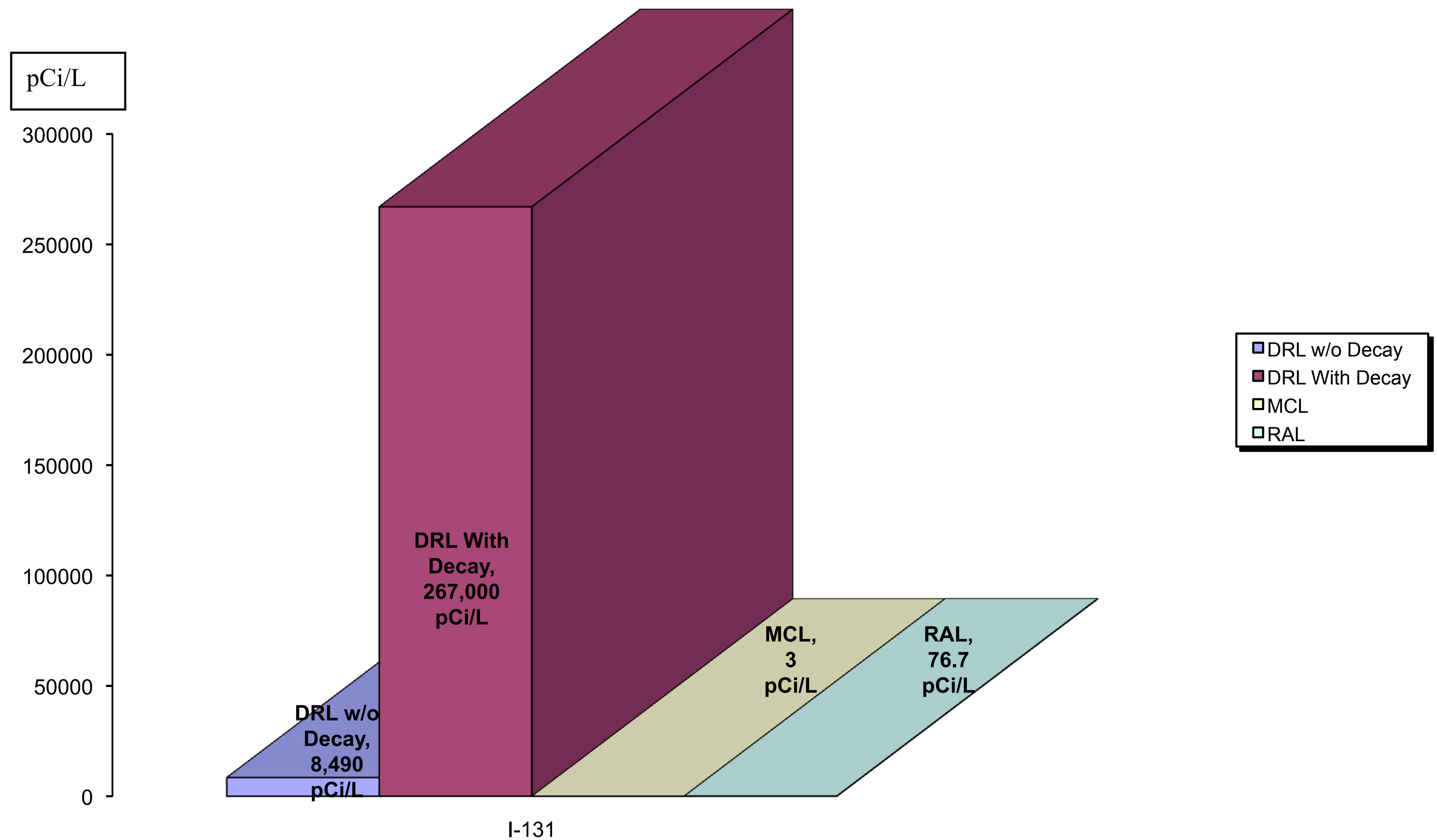


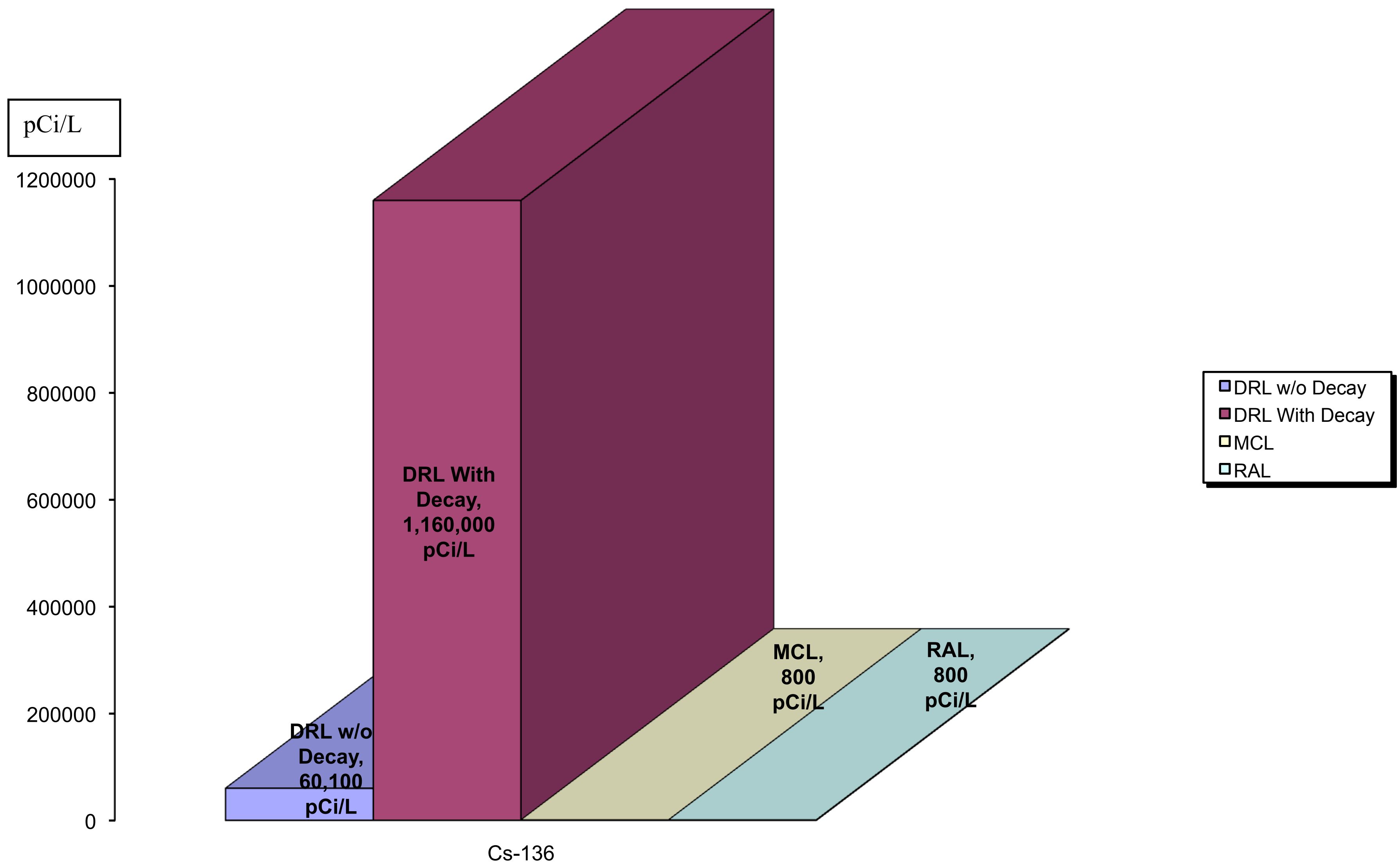
pCi/L
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 62,300 pCi/L
DRL With Decay, 468,000 pCi/L
MCL, 90 pCi/L
RAL, 221.1 pCi/L
Te-129m
DRL w/o Decay
DRL With Decay
MCL
RAL

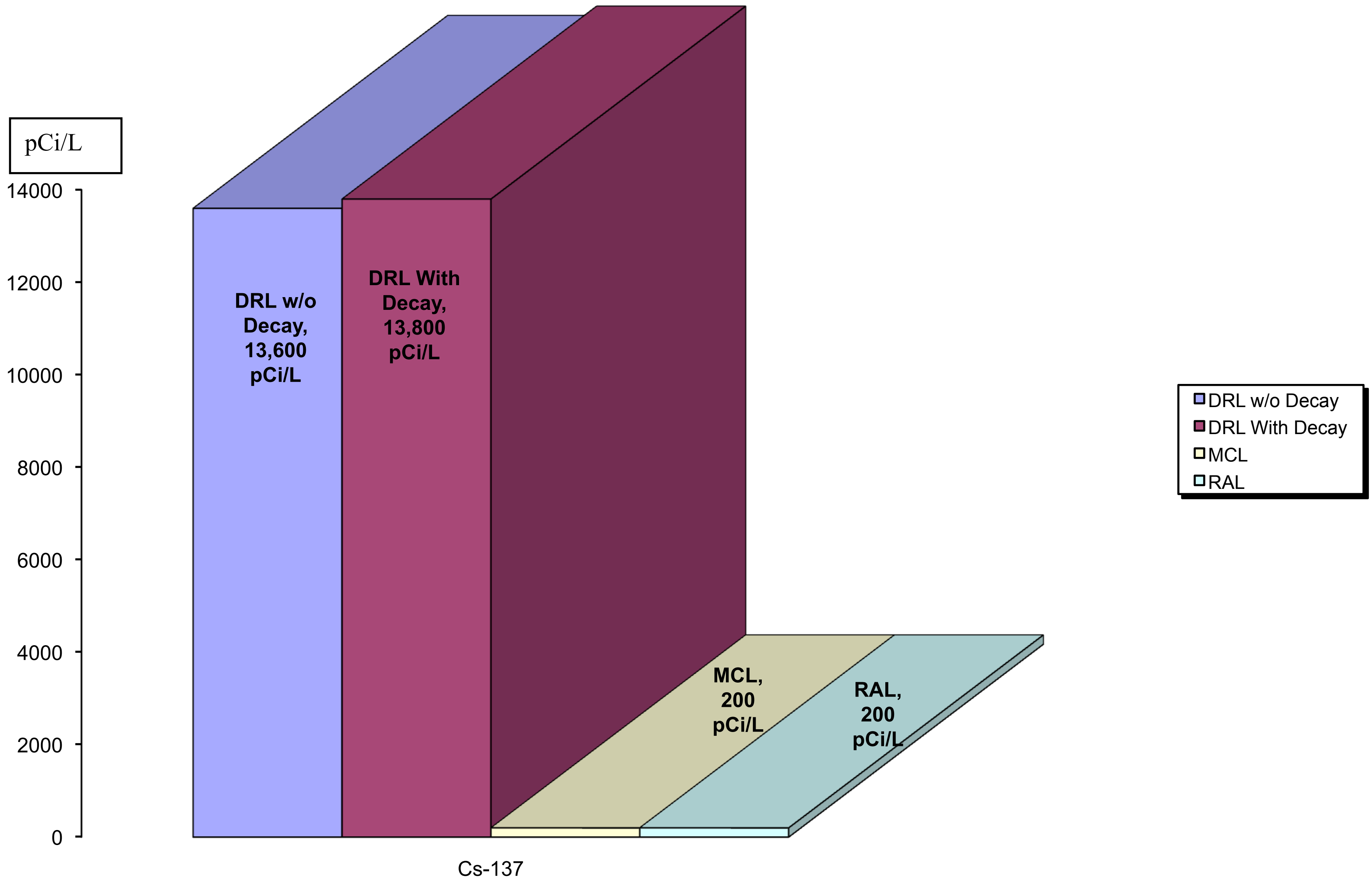

pCi/L
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
DRL With Decay, 3,780,000 pCi/g
DRL w/o Decay, 48,600 pCi/L
MCL, 90 pCi/L
RAL, 90 pCi/L
Te-132
DRL w/o Decay
DRL With Decay
MCL
RAL

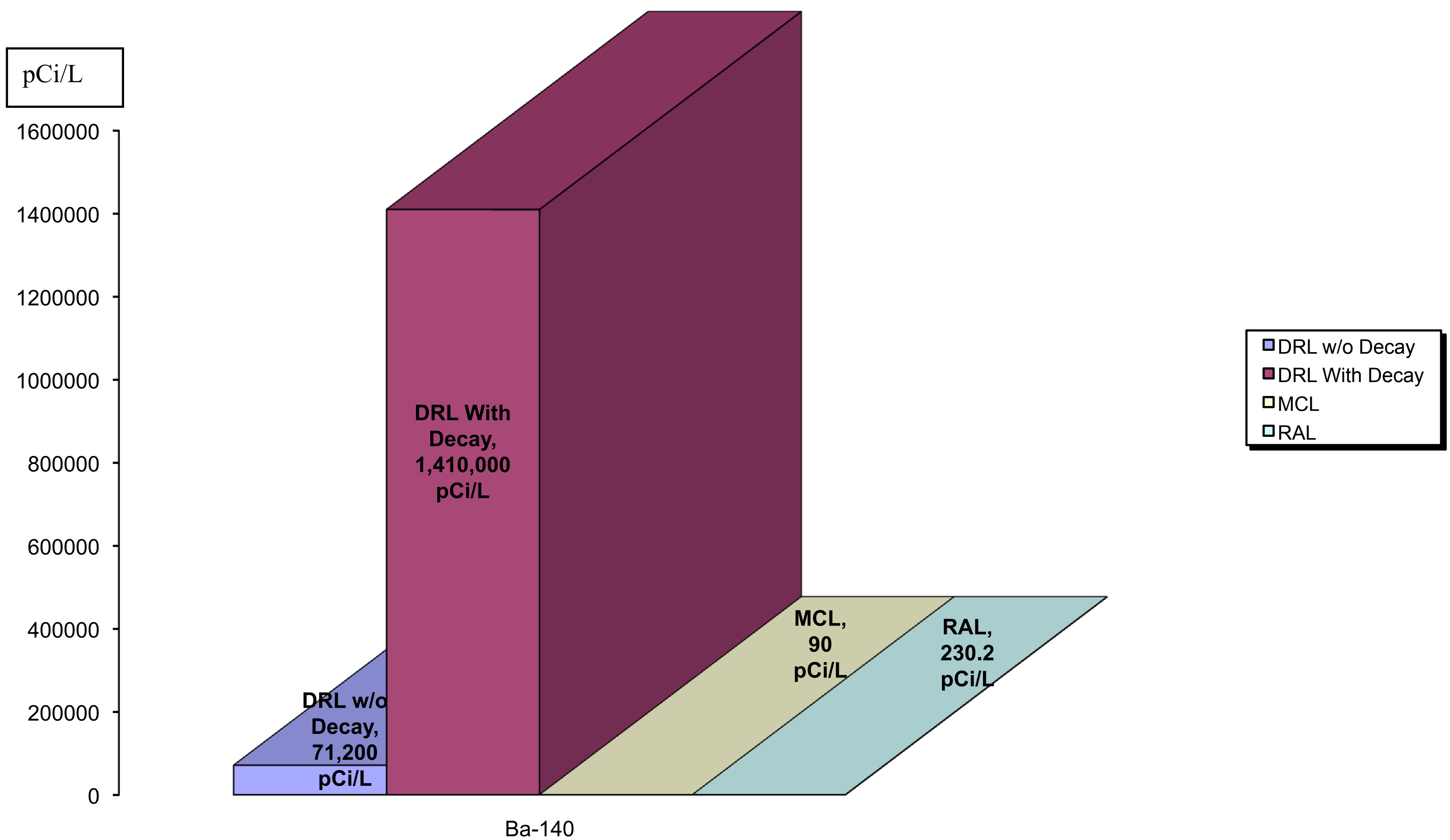

pCi/L
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
DRL With Decay, 3,780,000 pCi/L
DRL w/o Decay, 48,600 pCi/L
MCL, 90 pCi/L
RAL, 90 pCi/L
I-132
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
1800
1600
1400
1200
1000
800
600
400
200
0
DRL w/o Decay, 1,750 pCi/L
DRL With Decay, 1,750 pCi/L
MCL, 1 pCi/L
RAL, 23.7 pCi/L
I-129
DRL w/o Decay
DRL With Decay
MCL
RAL

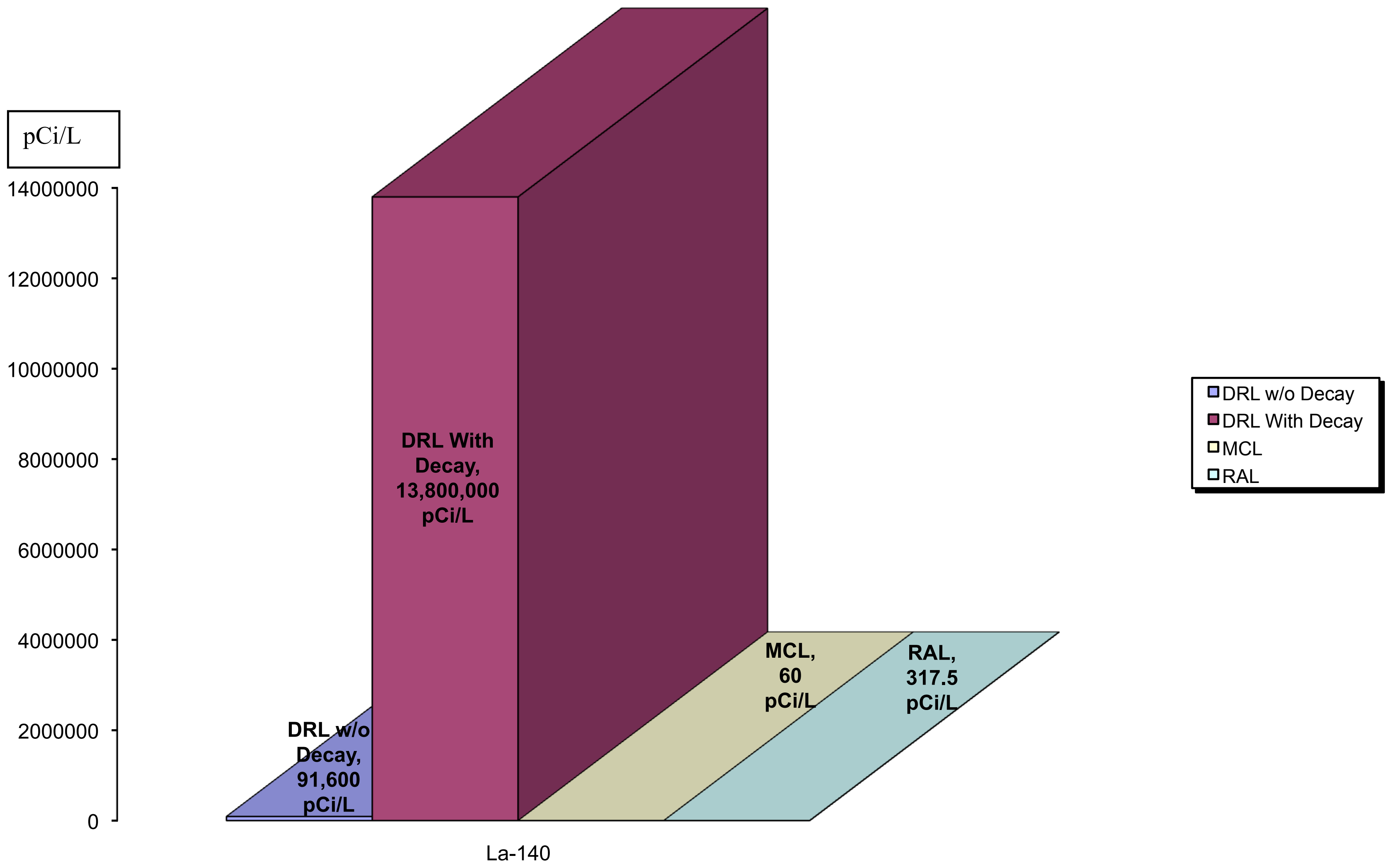

pCi/L
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 8,490 pCi/L
DRL With Decay, 267,000 pCi/L
MCL, 3 pCi/L
RAL, 76.7 pCi/L
I-131
DRL w/o Decay
DRL With Decay
MCL
RAL

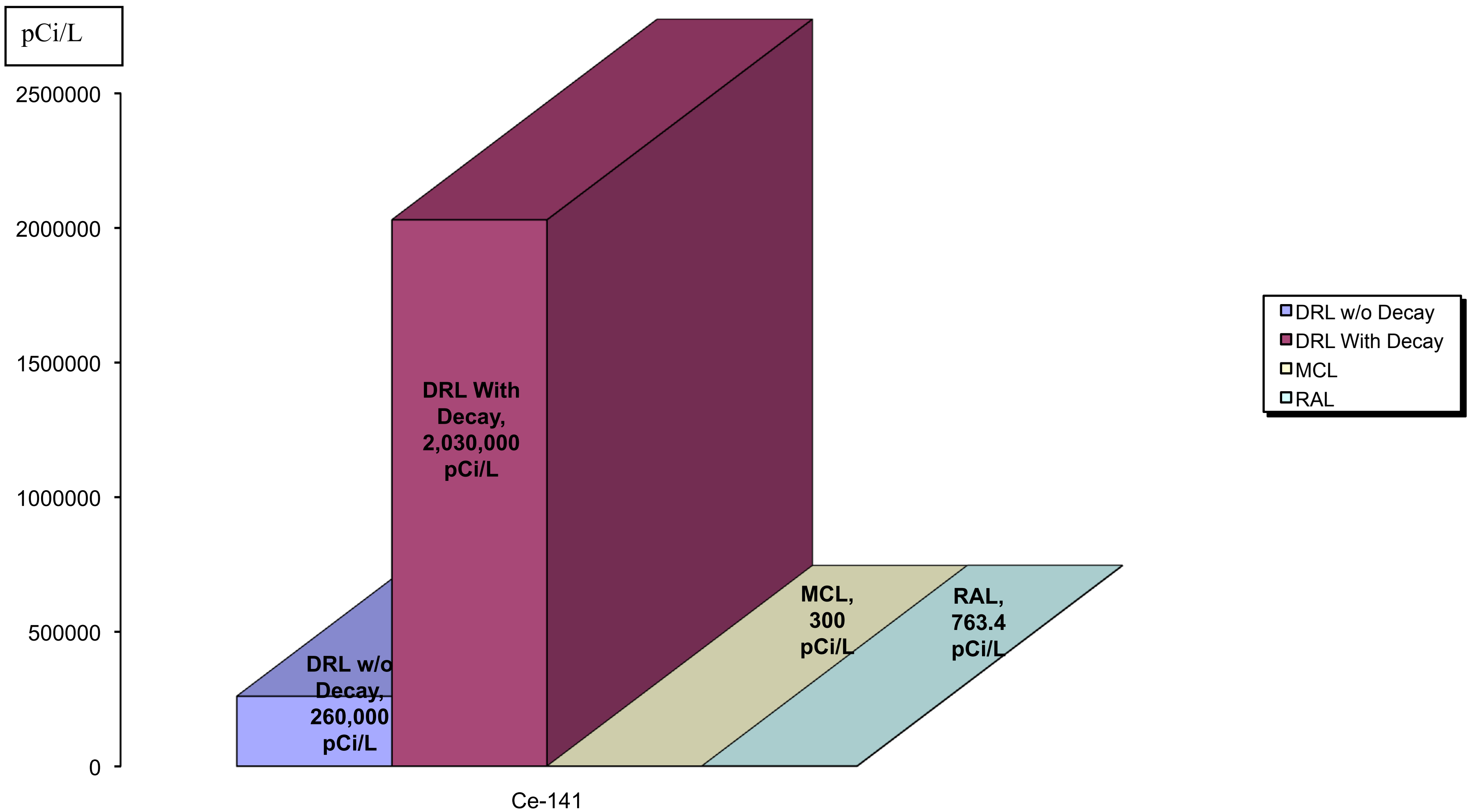

pCi/L
1200000
1000000
800000
600000
400000
200000
0
DRL w/o Decay, 60,100 pCi/L
DRL With Decay, 1,160,000 pCi/L
MCL, 800 pCi/L
RAL, 800 pCi/L
Cs-136
DRL w/o Decay
DRL With Decay
MCL
RAL

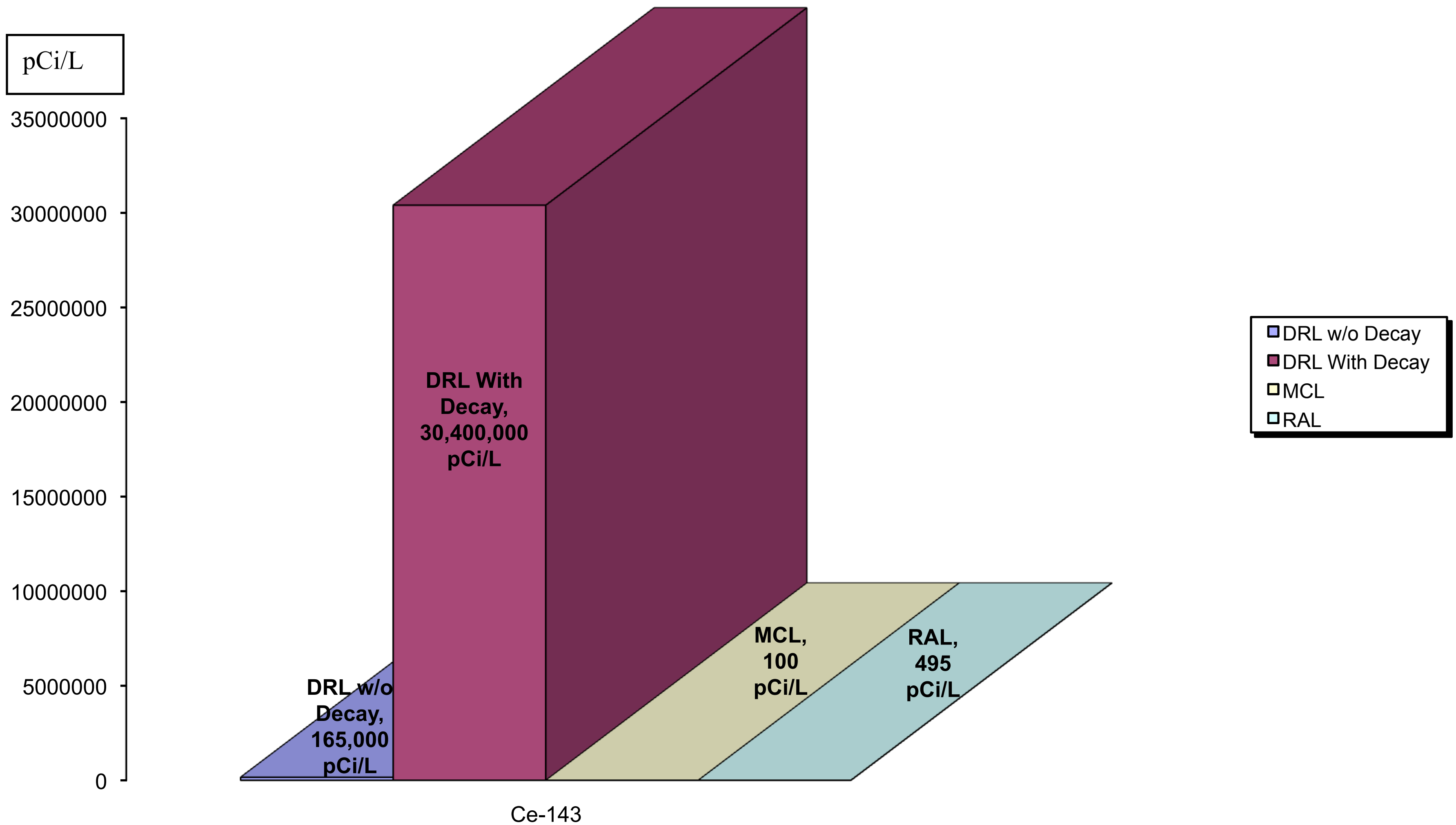

pCi/L
14000
12000
10000
8000
6000
4000
2000
0
DRL w/o Decay, 13,600 pCi/L
DRL With Decay, 13,800 pCi/L
MCL, 200 pCi/L
RAL, 200 pCi/L
Cs-137
DRL w/o Decay
DRL With Decay
MCL
RAL

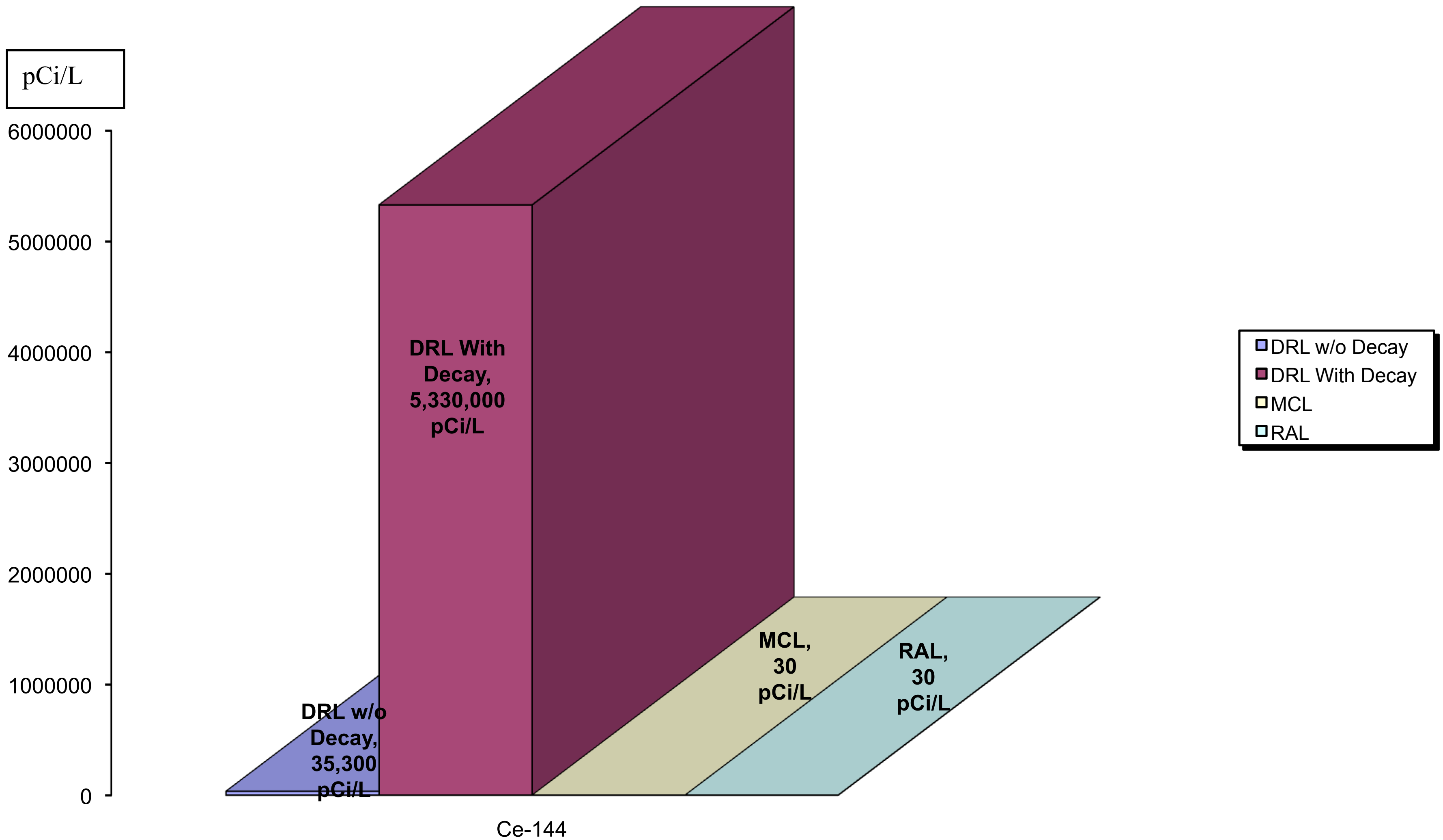


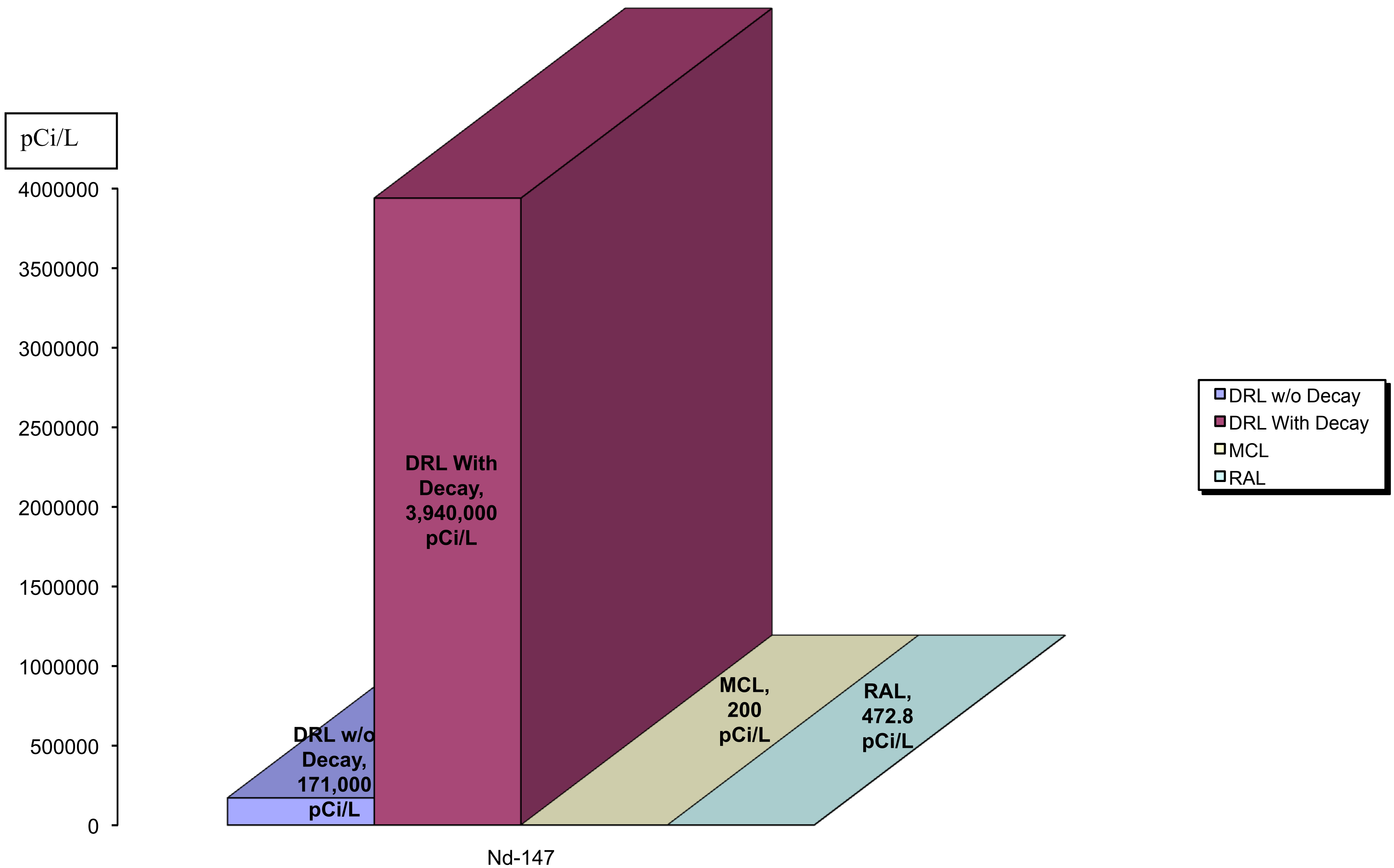
pCi/L
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
DRL w/o Decay, 71,200 pCi/L
DRL With Decay, 1,410,000 pCi/L
MCL, 90 pCi/L
RAL, 230.2 pCi/L
Ba-140
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
DRL With Decay, 13,800,000 pCi/L
DRL w/o Decay, 91,600 pCi/L
MCL, 60 pCi/L
RAL, 317.5 pCi/L
La-140
DRL w/o Decay
DRL With Decay
MCL
RAL

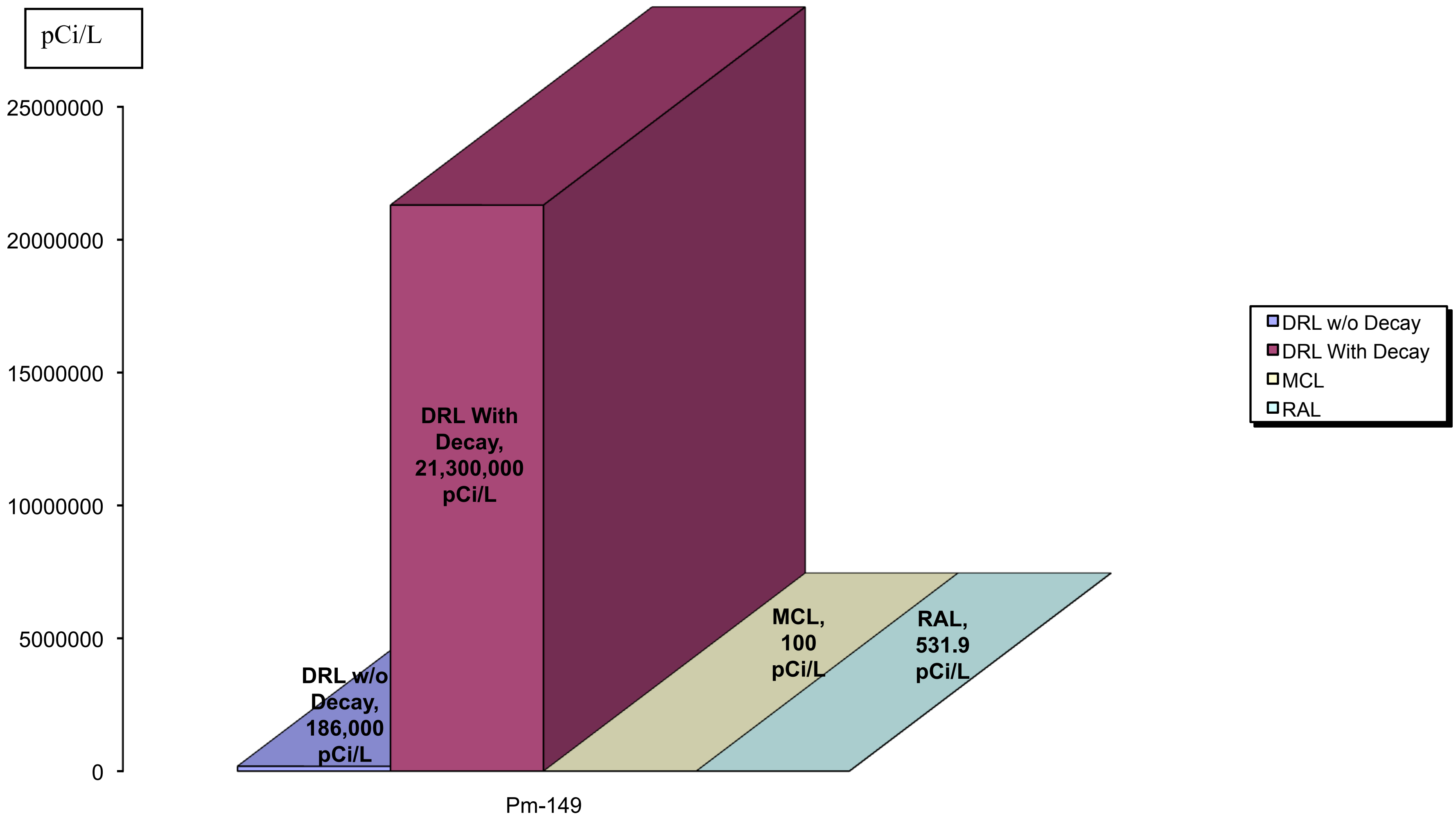

pCi/L
2500000
2000000
1500000
1000000
500000
0
DRL w/o Decay, 260,000 pCi/L
DRL With Decay, 2,030,000 pCi/L
MCL, 300 pCi/L
RAL, 763.4 pCi/L
Ce-141
DRL w/o Decay
DRL With Decay
MCL
RAL

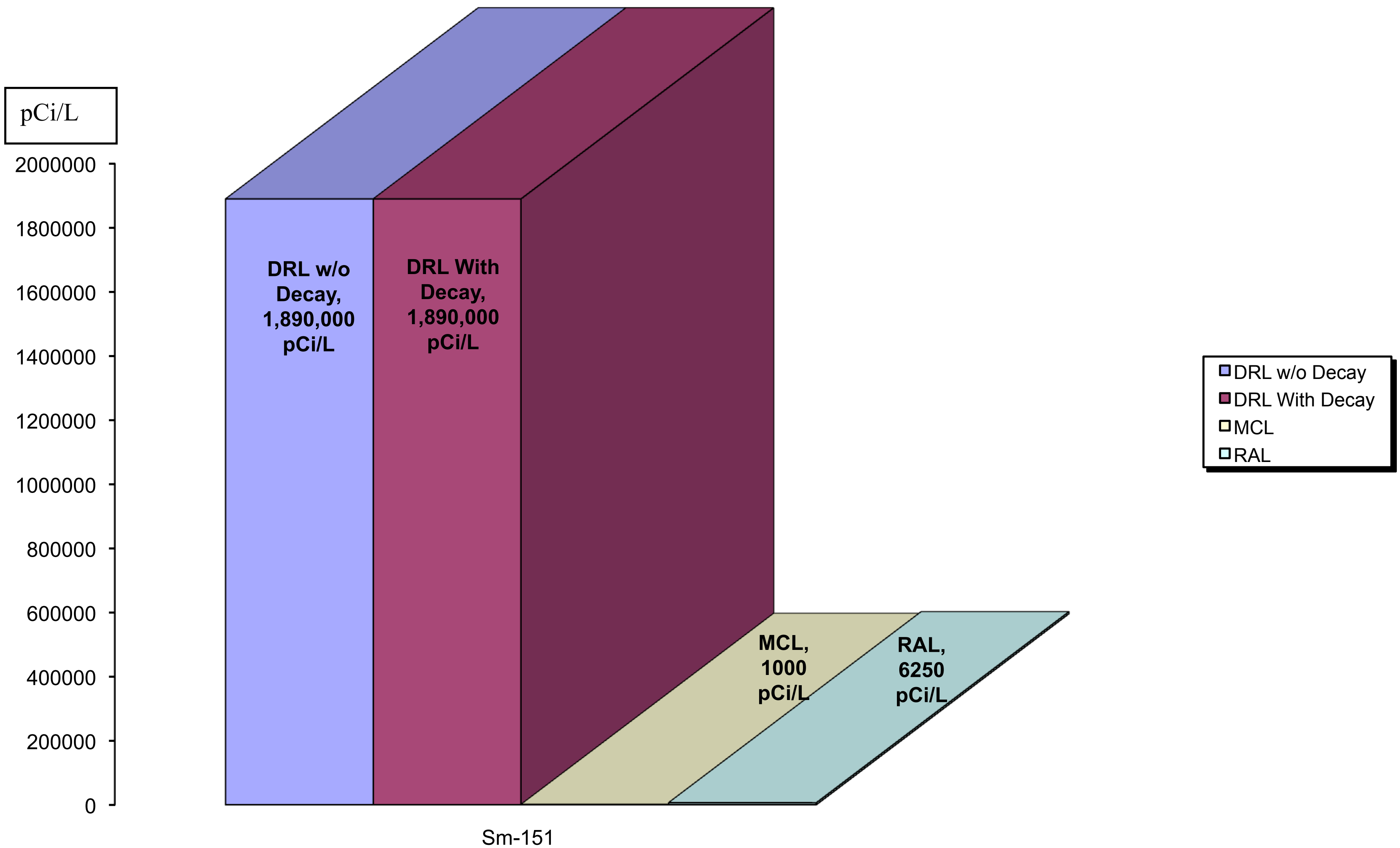

pCi/L
35000000
30000000
25000000
20000000
15000000
10000000
5000000
0
DRL w/o Decay, 165,000 pCi/L
DRL With Decay, 30,400,000 pCi/L
MCL, 100 pCi/L
RAL, 495 pCi/L
Ce-143
DRL w/o Decay
DRL With Decay
MCL
RAL

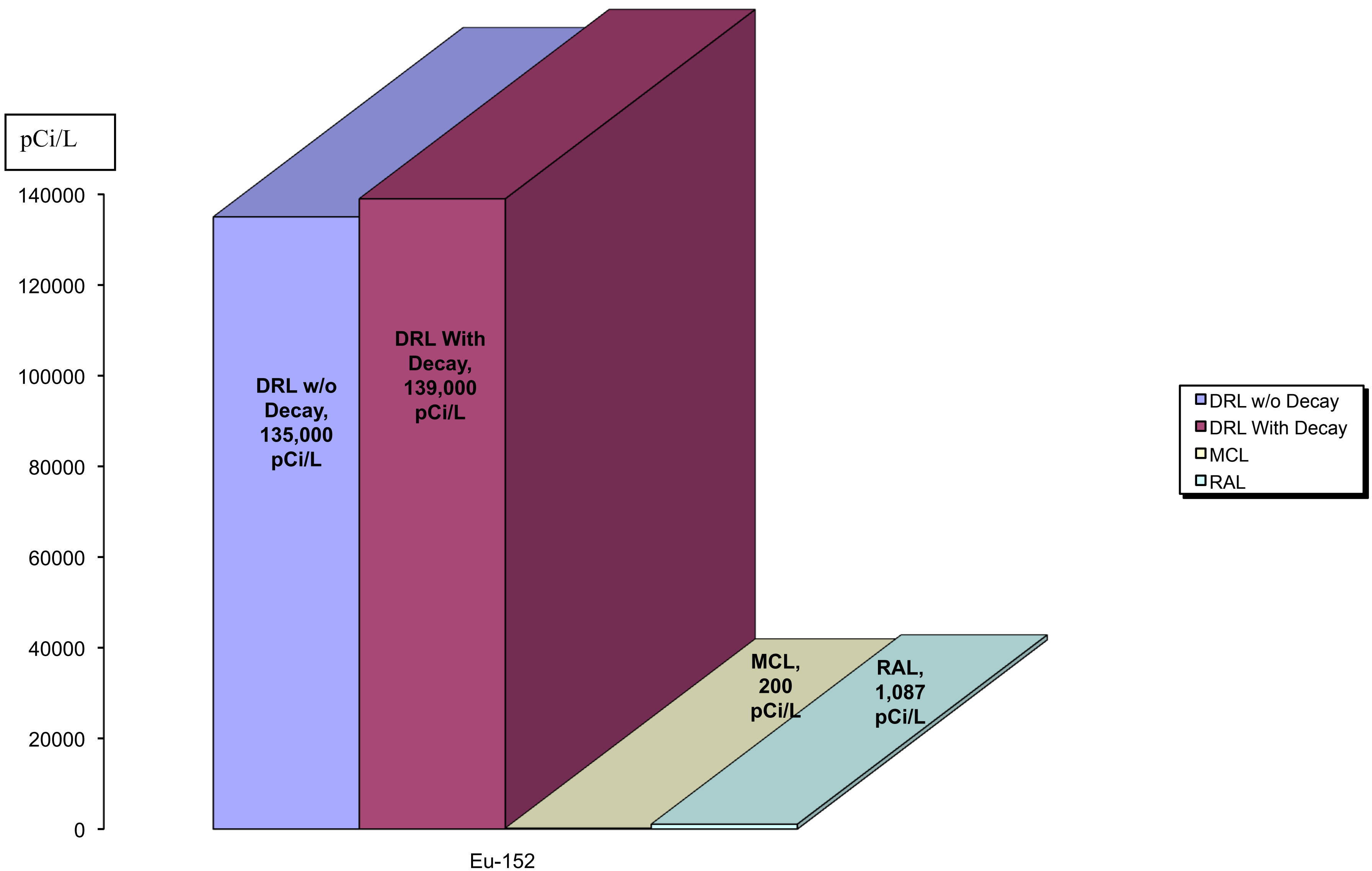

pCi/L
6000000
5000000
4000000
3000000
2000000
1000000
0
DRL With Decay, 5,330,000 pCi/L
DRL w/o Decay, 35,300 pCi/L
MCL, 30 pCi/L
RAL, 30 pCi/L
Ce-144
DRL w/o Decay
DRL With Decay
MCL
RAL



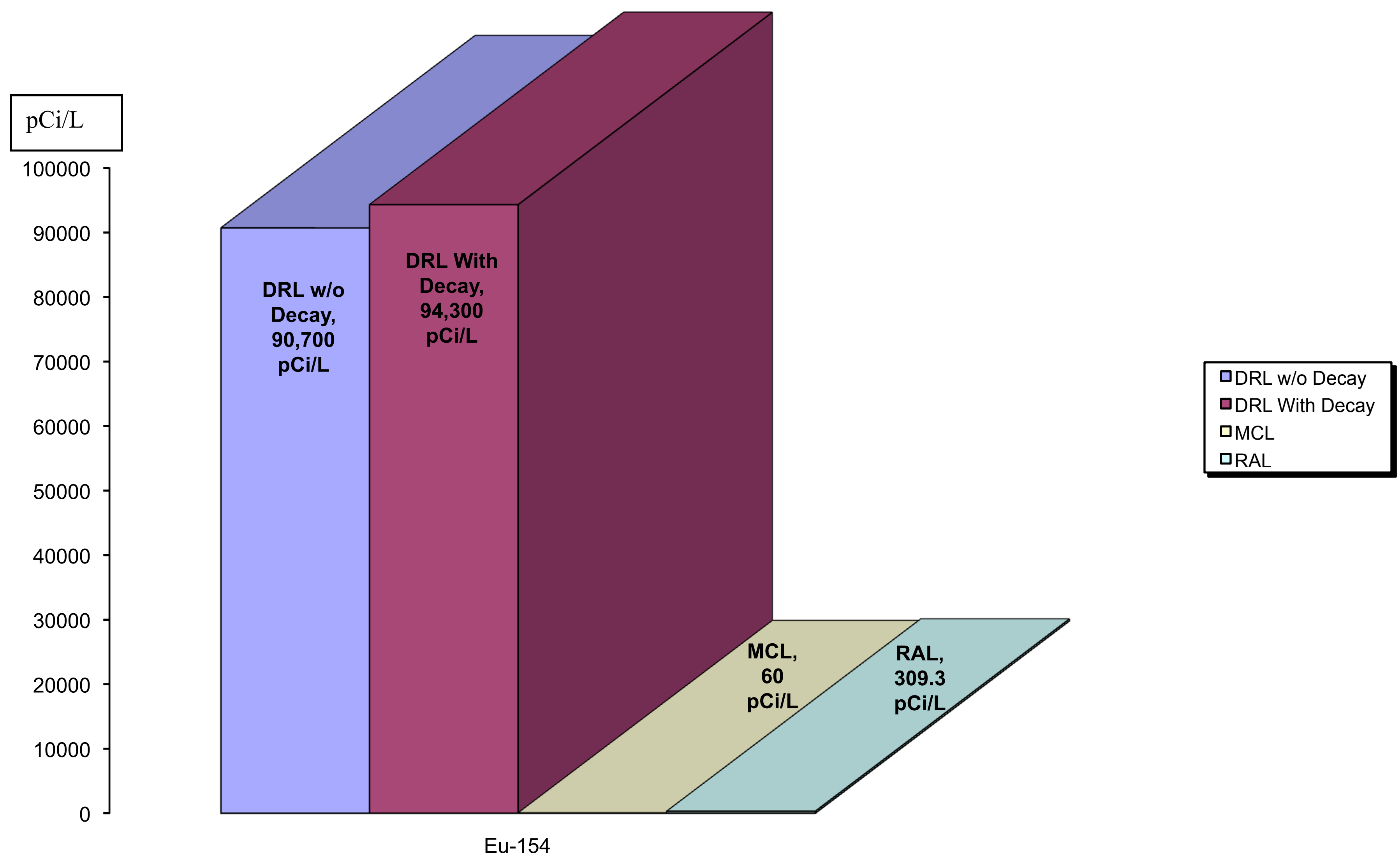
pCi/L
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
DRL With Decay, 3,940,000 pCi/L
DRL w/o Decay, 171,000 pCi/L
MCL, 200 pCi/L
RAL, 472.8 pCi/L
Nd-147
DRL w/o Decay
DRL With Decay
MCL
RAL

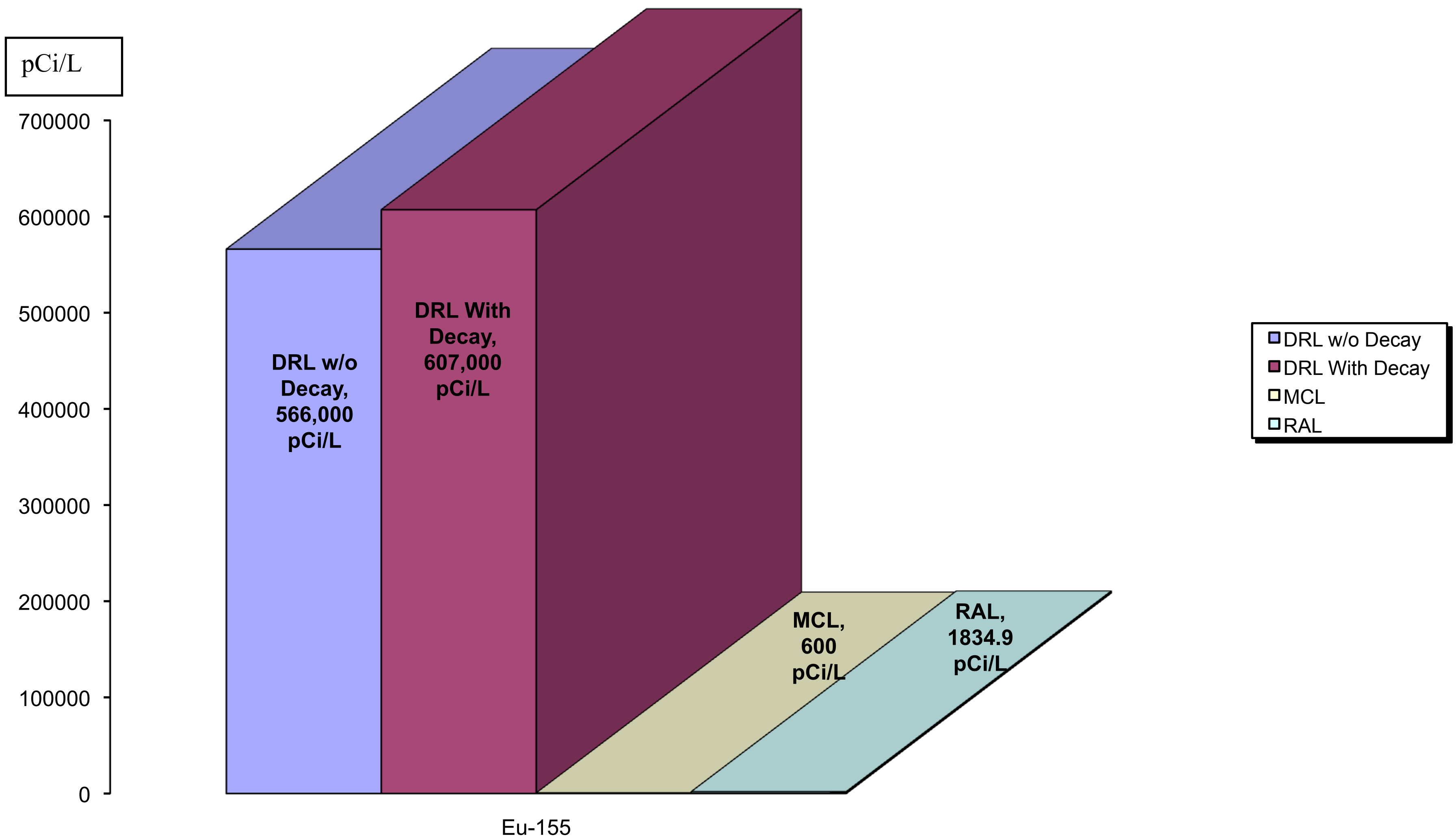

pCi/L
25000000
20000000
15000000
10000000
5000000
0
DRL With Decay, 21,300,000 pCi/L
DRL w/o Decay, 186,000 pCi/L
MCL, 100 pCi/L
RAL, 531.9 pCi/L
Pm-149
DRL w/o Decay
DRL With Decay
MCL
RAL

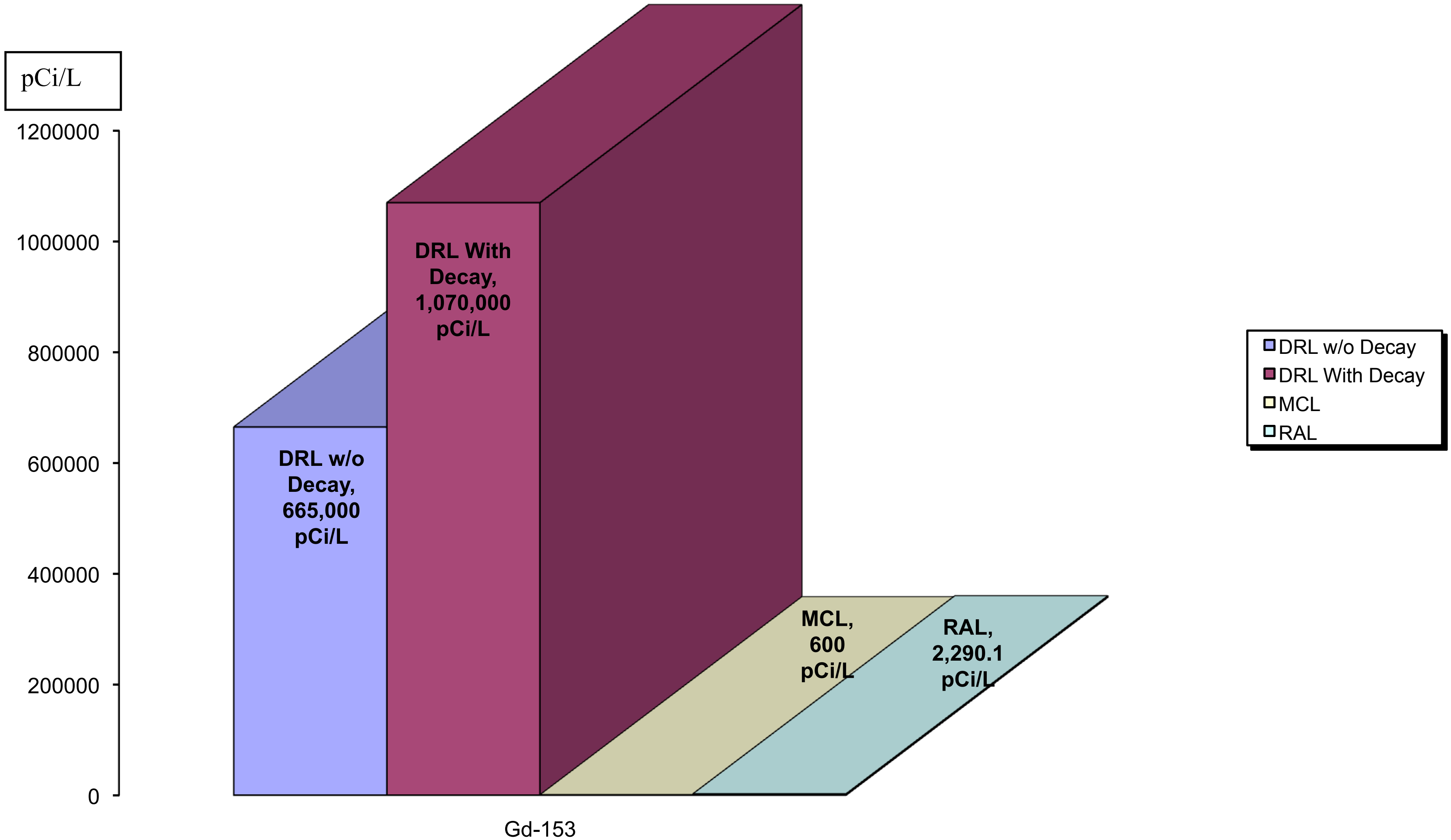

pCi/L
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
DRL w/o Decay, 1,890,000 pCi/L
DRL With Decay, 1,890,000 pCi/L
MCL, 1000 pCi/L
RAL, 6250 pCi/L
Sm-151
DRL w/o Decay
DRL With Decay
MCL
RAL

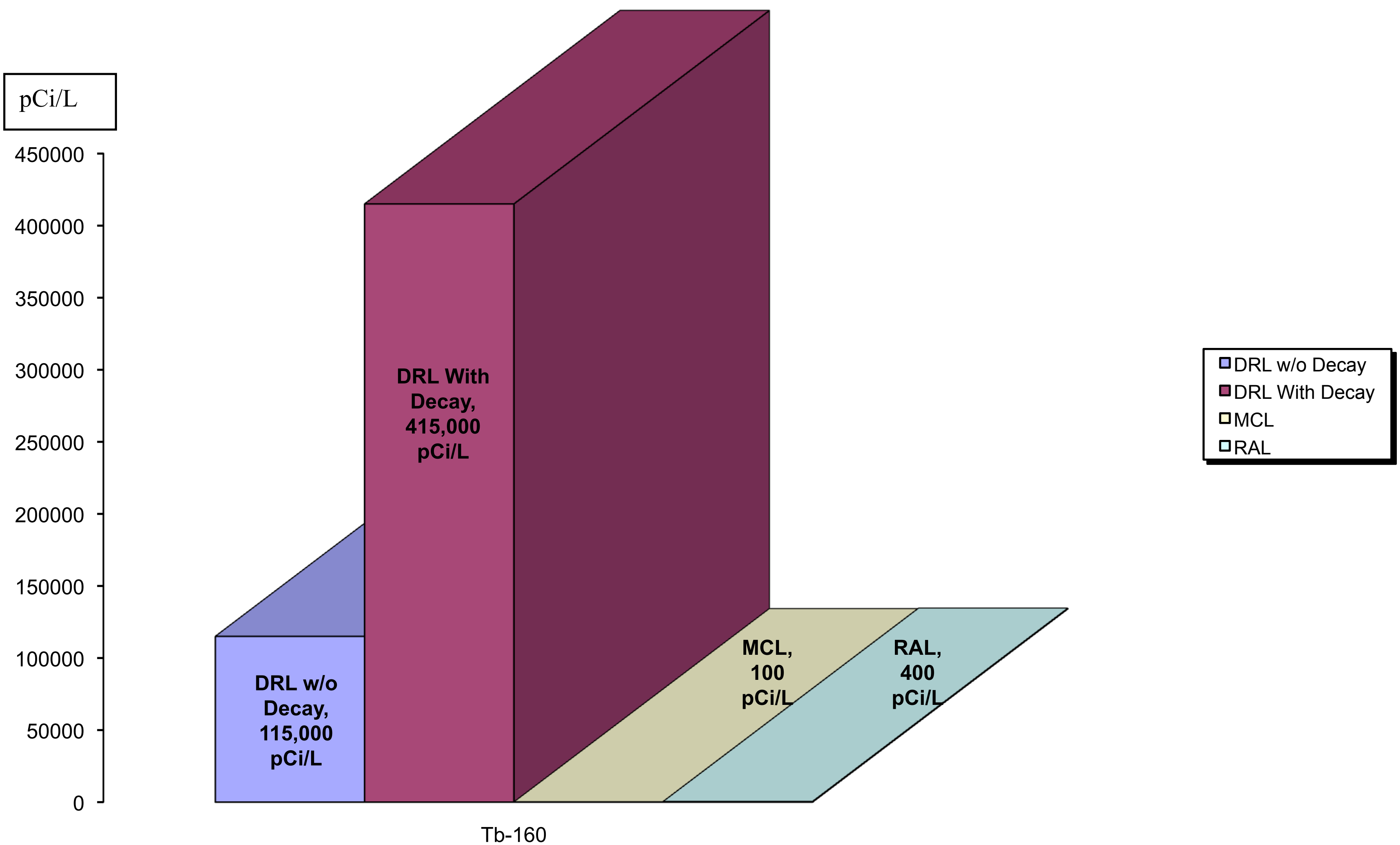


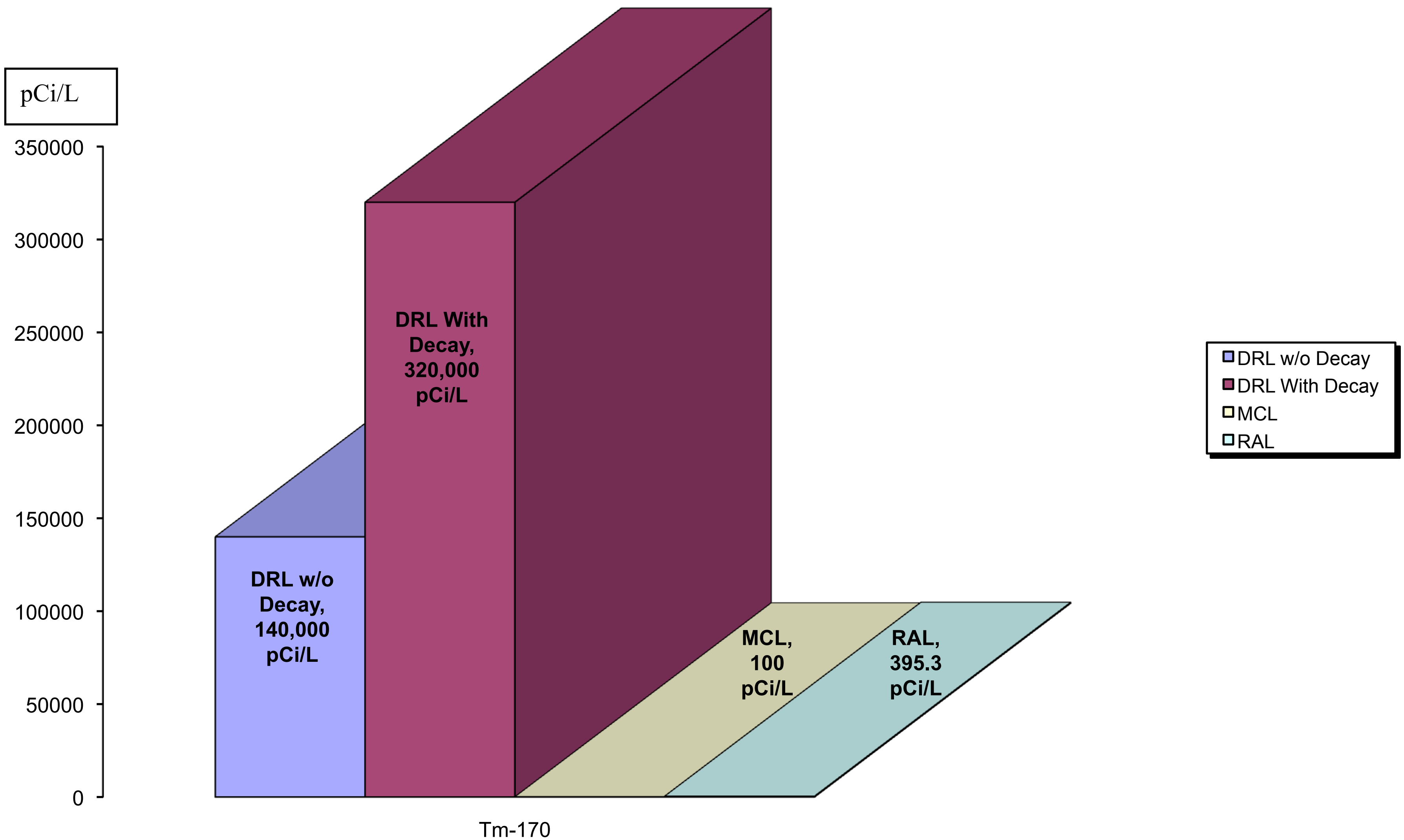
pCi/L
140000
120000
100000
80000
60000
40000
20000
0
DRL w/o Decay, 135,000 pCi/L
DRL With Decay, 139,000 pCi/L
MCL, 200 pCi/L
RAL, 1,087 pCi/L
Eu-152
DRL w/o Decay
DRL With Decay
MCL
RAL

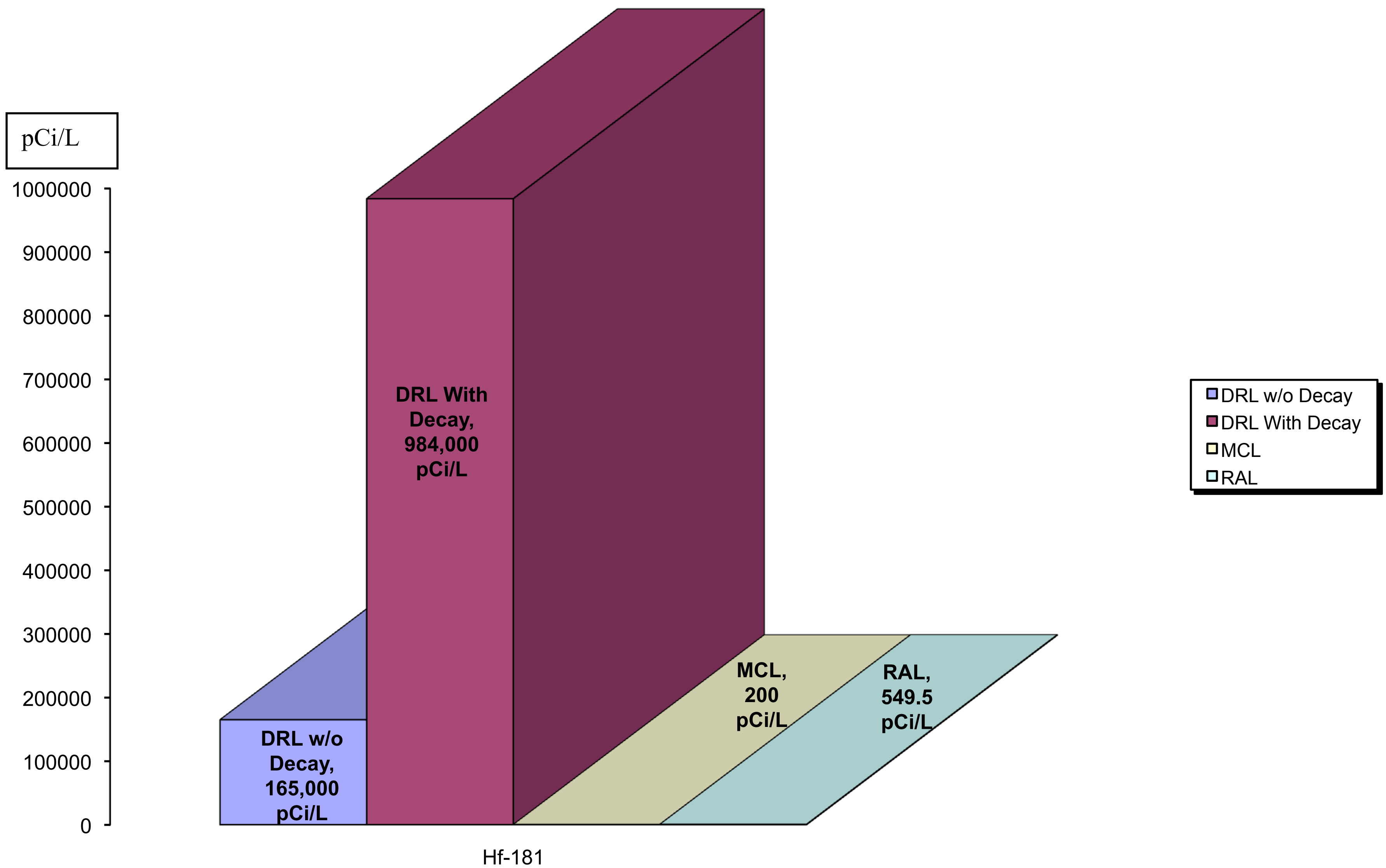

pCi/L
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
DRL w/o Decay, 90,700 pCi/L
DRL With Decay, 94,300 pCi/L
MCL, 60 pCi/L
RAL, 309.3 pCi/L
Eu-154
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
700000
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 566,000 pCi/L
DRL With Decay, 607,000 pCi/L
MCL, 600 pCi/L
RAL, 1834.9 pCi/L
Eu-155
DRL w/o Decay
DRL With Decay
MCL
RAL

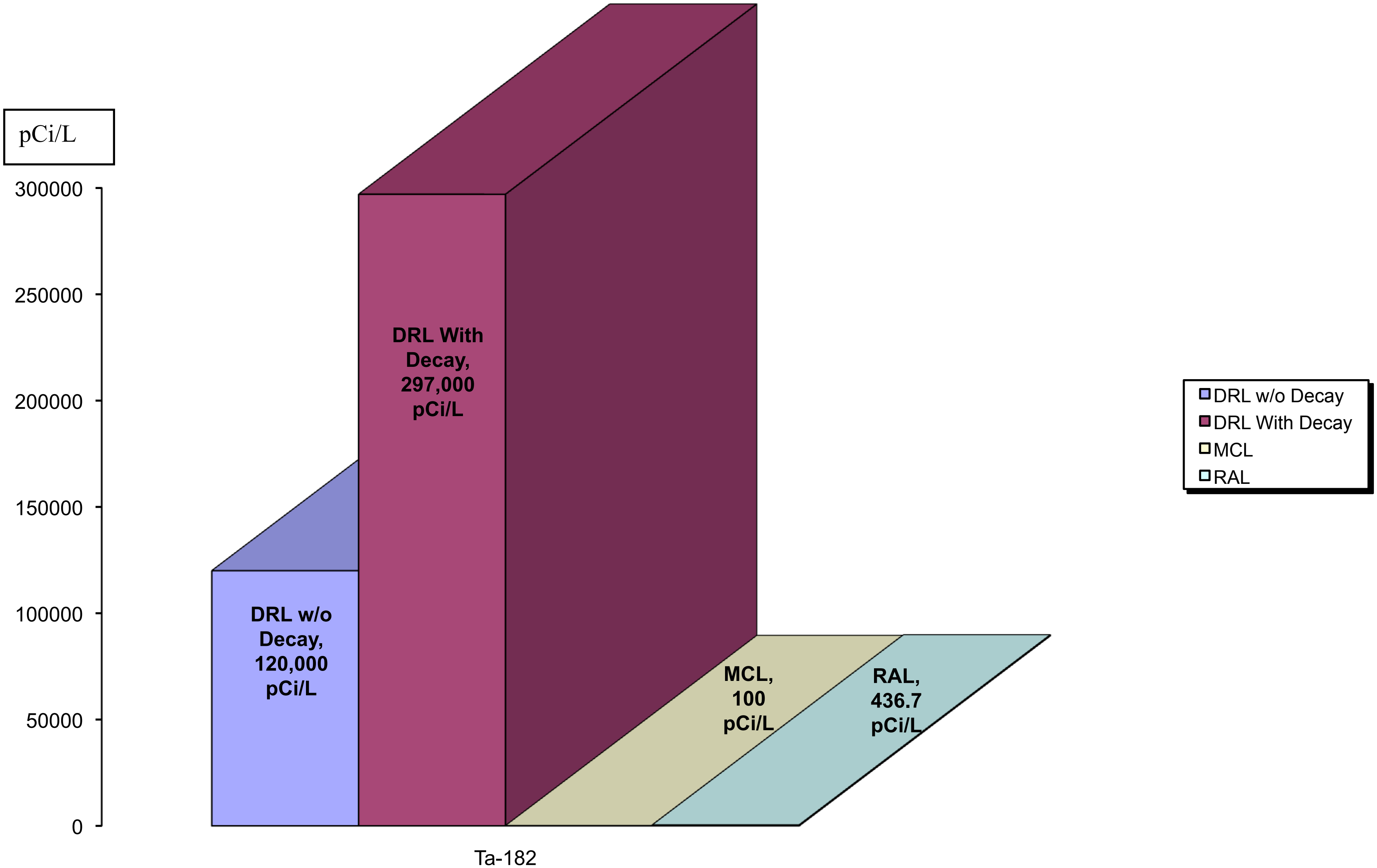

pCi/L
1200000
1000000
800000
600000
400000
200000
0
DRL w/o Decay, 665,000 pCi/L
DRL With Decay, 1,070,000 pCi/L
MCL, 600 pCi/L
RAL, 2,290.1 pCi/L
Gd-153
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
DRL With Decay, 415,000 pCi/L
DRL w/o Decay, 115,000 pCi/L
MCL, 100 pCi/L
RAL, 400 pCi/L
Tb-160
DRL w/o Decay
DRL With Decay
MCL
RAL

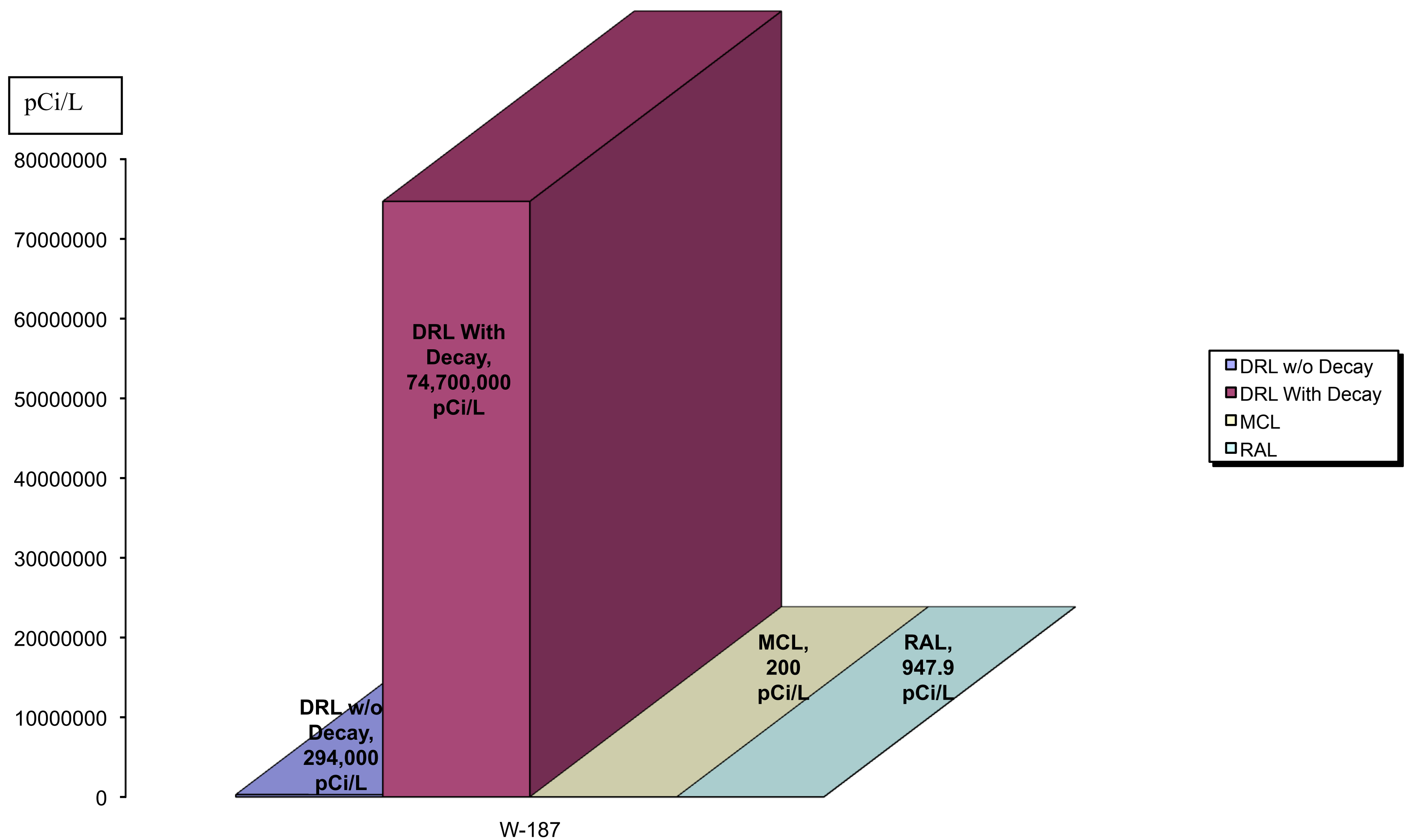

pCi/L
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 140,000 pCi/L
DRL With Decay, 320,000 pCi/L
MCL, 100 pCi/L
RAL, 395.3 pCi/L
Tm-170
DRL w/o Decay
DRL With Decay
MCL
RAL

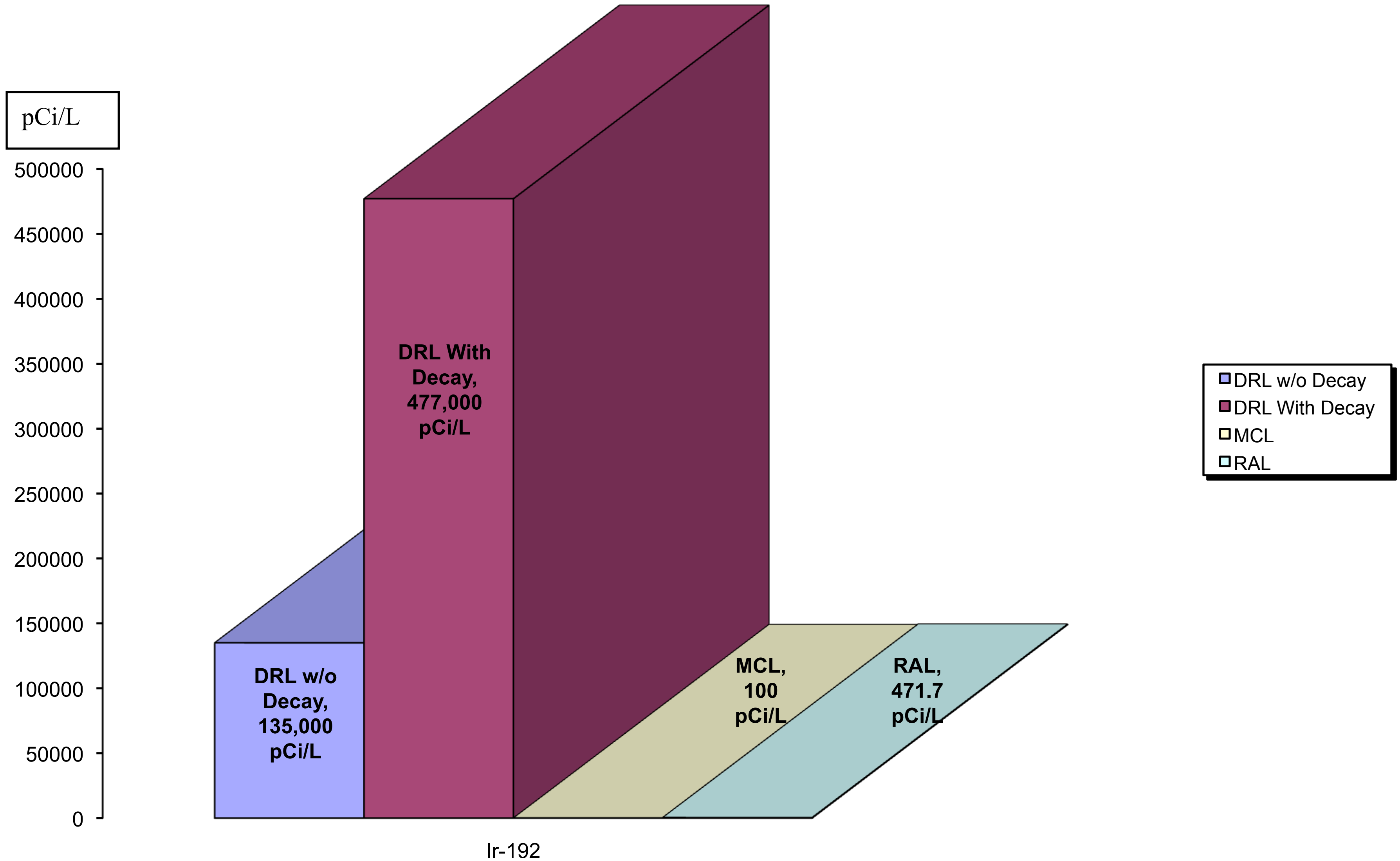


pCi/L
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
DRL With Decay, 984,000 pCi/L
DRL w/o Decay, 165,000 pCi/L
MCL, 200 pCi/L
RAL, 549.5 pCi/L
Hf-181
DRL w/o Decay
DRL With Decay
MCL
RAL

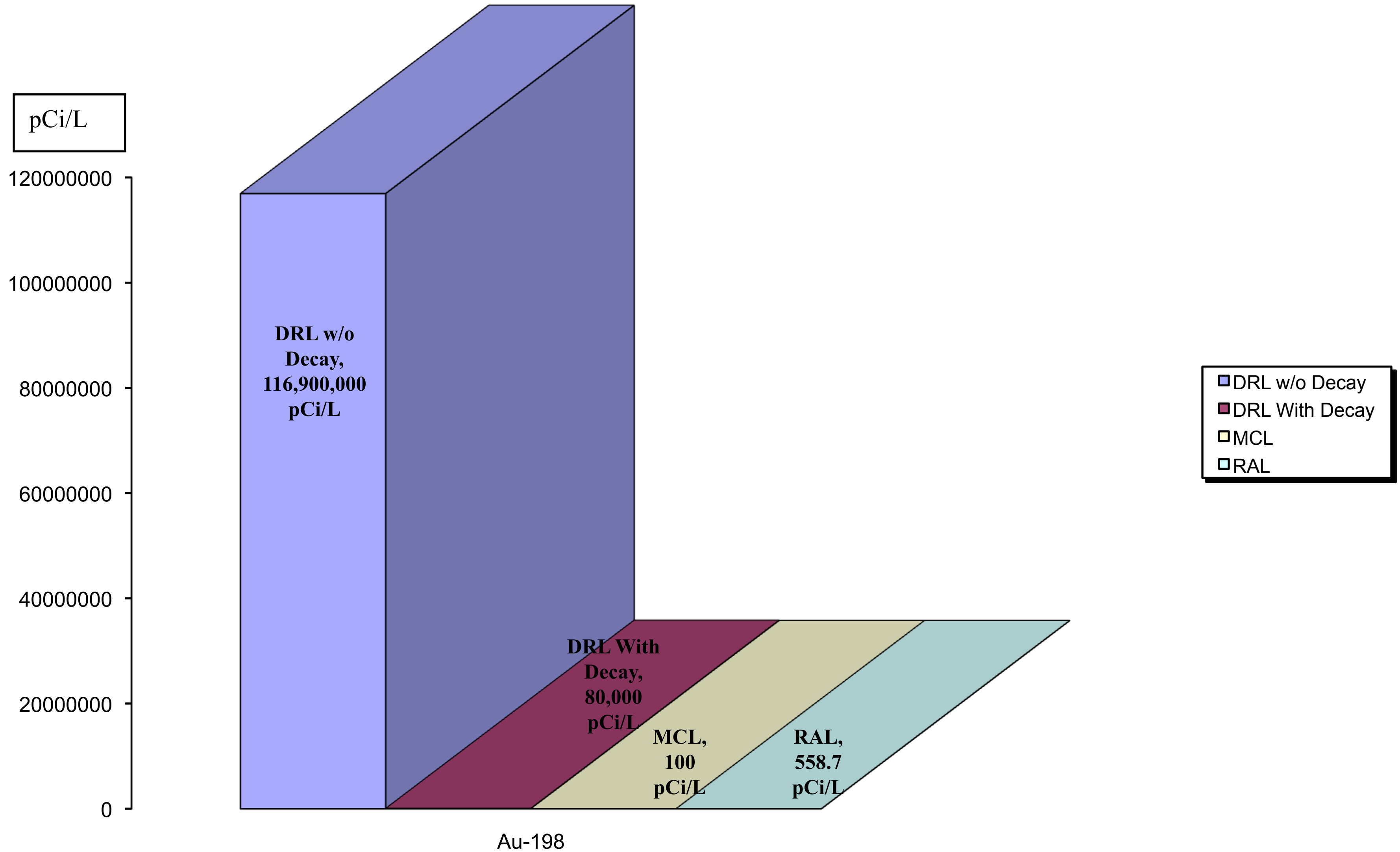


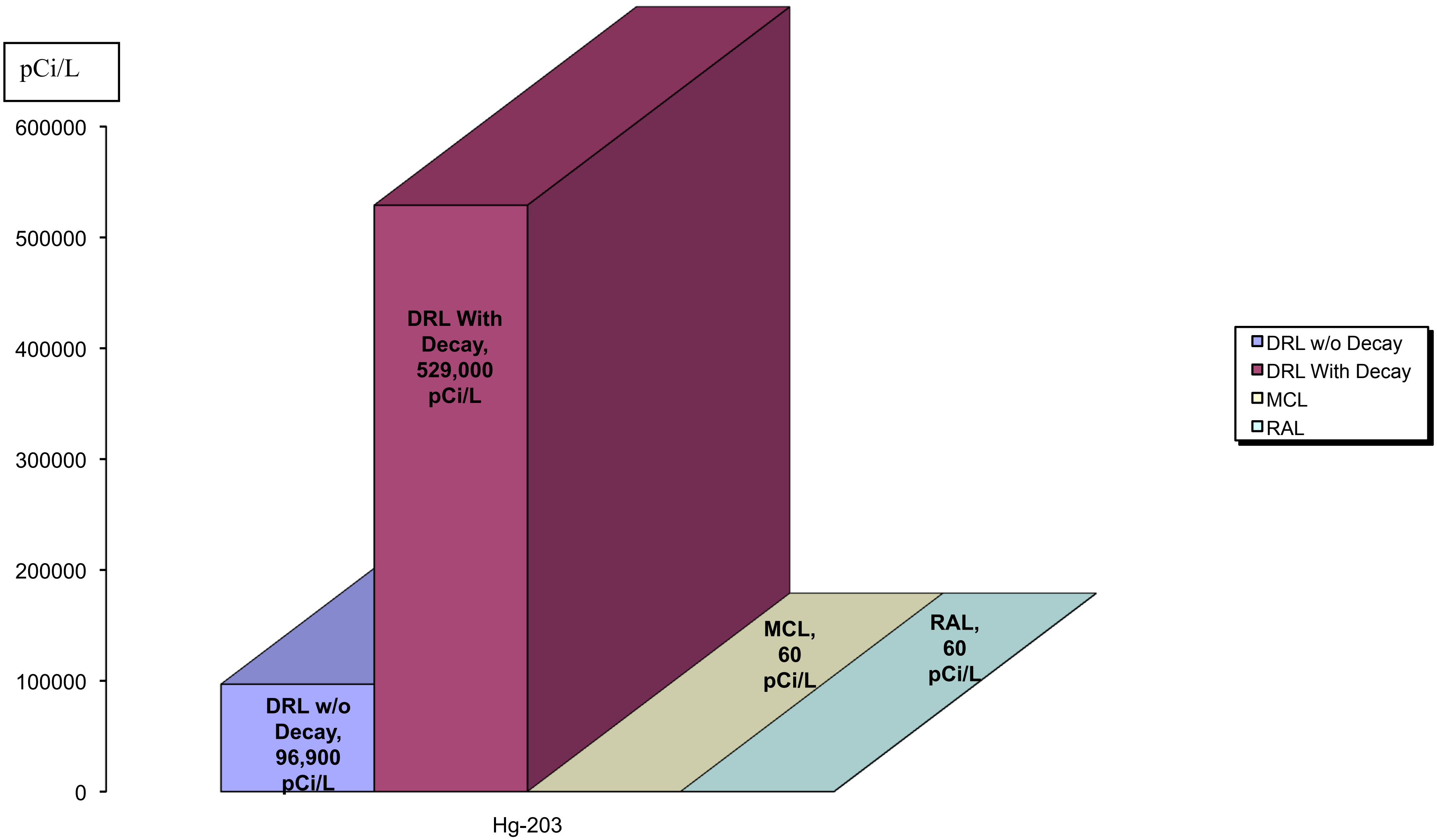
pCi/L
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 120,000 pCi/L
DRL With Decay, 297,000 pCi/L
MCL, 100 pCi/L
RAL, 436.7 pCi/L
Ta-182
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
80000000
70000000
60000000
50000000
40000000
30000000
20000000
10000000
0
DRL With Decay, 74,700,000 pCi/L
DRL w/o Decay, 294,000 pCi/L
MCL, 200 pCi/L
RAL, 947.9 pCi/L
W-187
DRL w/o Decay
DRL With Decay
MCL
RAL

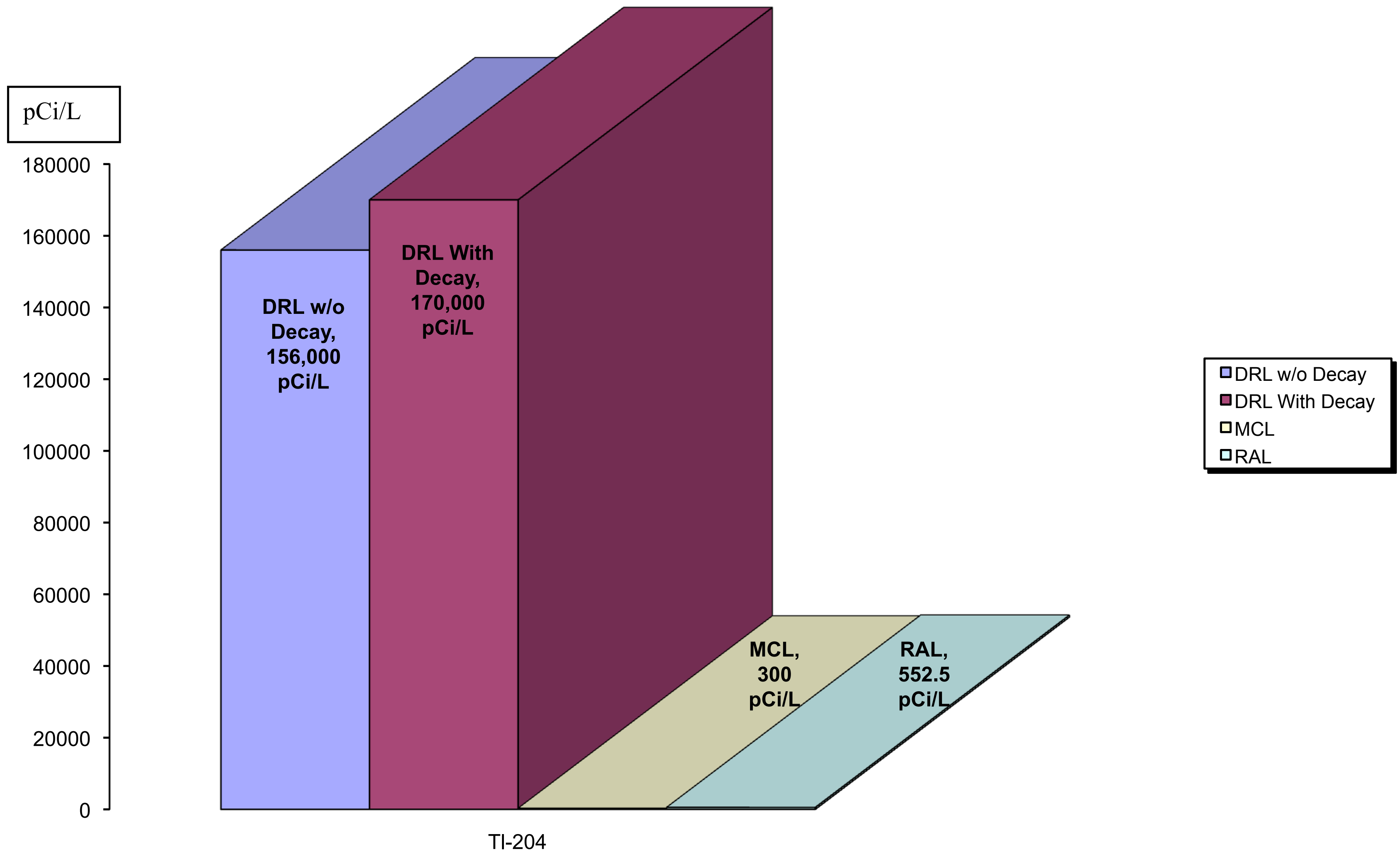


pCi/L
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
DRL w/o Decay, 135,000 pCi/L
DRL With Decay, 477,000 pCi/L
MCL, 100 pCi/L
RAL, 471.7 pCi/L
Ir-192
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
120000000
100000000
80000000
60000000
40000000
20000000
0
DRL w/o Decay, 116,900,000 pCi/L
DRL With Decay, 80,000 pCi/L
MCL, 100 pCi/L
RAL, 558.7 pCi/L
Au-198
DRL w/o Decay
DRL With Decay
MCL
RAL



pCi/L
600000
500000
400000
300000
200000
100000
0
DRL w/o Decay, 96,900 pCi/L
DRL With Decay, 529,000 pCi/L
MCL, 60 pCi/L
RAL, 60 pCi/L
Hg-203
DRL w/o Decay
DRL With Decay
MCL
RAL


pCi/L
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
DRL w/o Decay, 156,000 pCi/L
DRL With Decay, 170,000 pCi/L
MCL, 300 pCi/L
RAL, 552.5 pCi/L
Tl-204
DRL w/o Decay
DRL With Decay
MCL
RAL

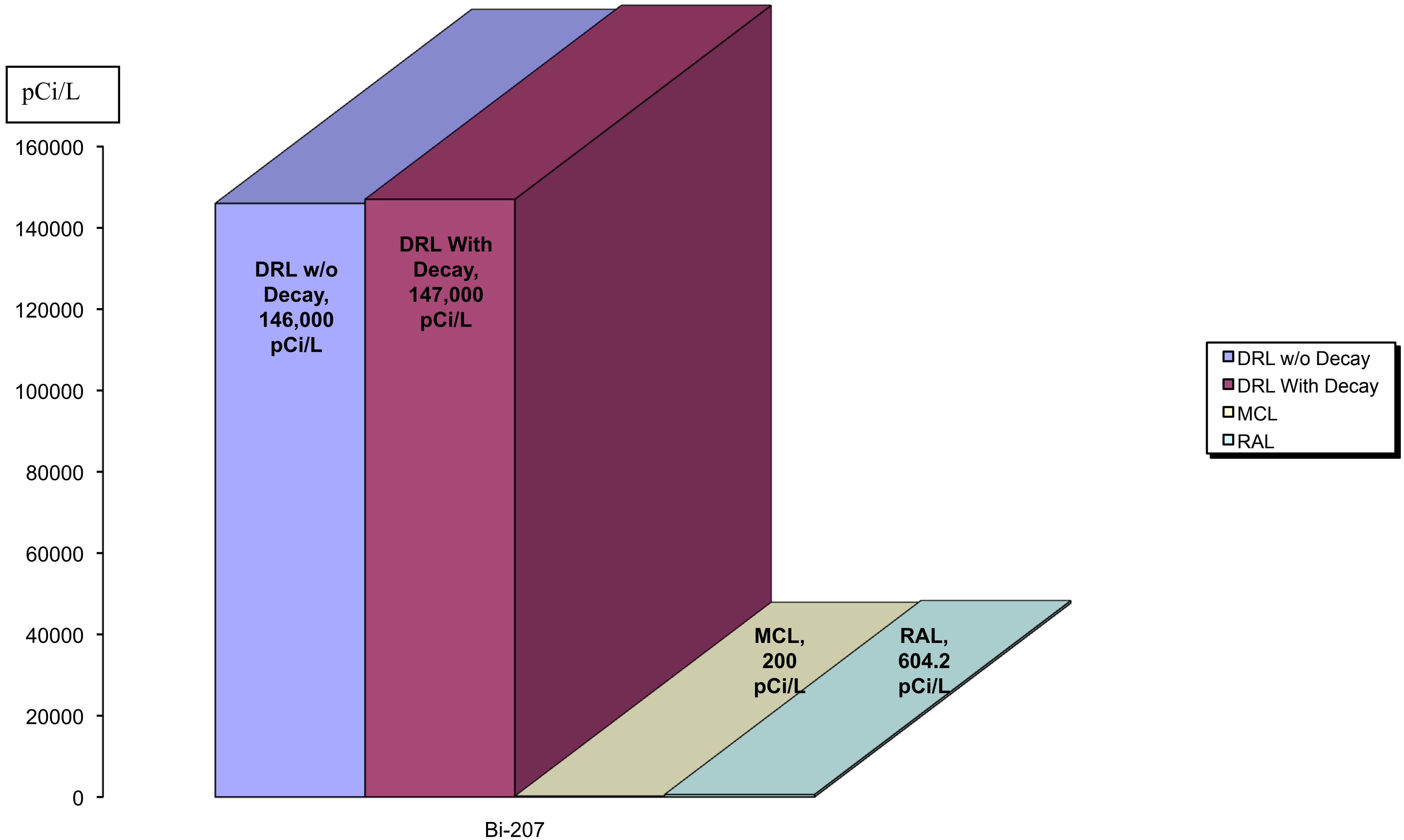

pCi/L
160000
140000
120000
100000
80000
60000
40000
20000
0
DRL w/o Decay, 146,000 pCi/L
DRL With Decay, 147,000 pCi/L
MCL, 200 pCi/L
RAL, 604.2 pCi/L
Bi-207
DRL w/o Decay
DRL With Decay
MCL
RAL

TABLE 6

DERIVATION OF CURRENT EPA REMOVAL ACTION LEVELS (RALS) FOR RADIOACTIVITY IN DRINKING WATER

NOTE: Existing EPA standards for when alternative drinking water supplies are to be provided in emergency situations are the Removal Action Levels (RALs). They are derived by calculating the concentration of a particular radionuclide that will produce a 10^{-4} (1 in 10,000) cancer risk and then comparing that concentration with the Maximum Concentration Limit (MCL) specified by EPA under the Safe Drinking Water Act. Whichever is greater is used as the RAL. See EPA policy for when to provide drinking water during emergencies and the method for deriving RALs in *Final Guidance on Numeric Removal Action Levels for Contaminated Drinking Water Sites*, 25 October 1993, from Deborah Dietrich, Director, Emergency Response Division, EPA. EPA's current risk figures for converting MCLs to RALs are found in *Radionuclides Notice of Data Availability,* prepared by Targeting and Analysis Branch, Standards and Risk Management Division, USEPA Office of Ground Water and Drinking Water, in collaboration with USEPA Office of Indoor Air & Radiation and the U.S. Geological Survey, March 2000. The following table for beta particle and photon-emitting radionuclides calculates the 10^{-4} concentration using the above EPA-specified methodology (the risk figures are from Table III-3 of the *Radionuclides Notice of Data Availability*), compares it to the MCL, and identifies the RAL that derives therefrom. [The 10^{-4} concentrations for determining RALs for alpha-emitting radionuclides are reported directly in Table III-4 of that document.]

TABLE 6: CALCULATION OF REMOVAL ACTION LEVELS (RALs) and comparisons with Proposed Derived Response Levels (DRLs) and Existing Maximum Concentration Levels (MCLs)

Radionuclide	DRL w/o Decay*	DRL With Decay*	Maximum Containment Level (MCL)*	Cancer Risk for (MCL)	10-4 Cancer Risk	Removal Action Level (RAL)*
H-3	4,420,000	4,540,000	20,000	**3.57E-05**	56,022	56,022
C-14	319,000	319,000	2,000	**1.09E-04**	1,835	2,000
Na-22	58,000	66,100	400	**1.36E-04**	294	400
P-32	77,100	1,370,000	30	**9.53E-06**	315	315
S-35	239,000	731,000	500	**8.39E-06**	5,959	5,960
Cl-36	199,000	199,000	700	**7.86E-05**	891	891
Ca-45	260,000	513,000	10	**8.96E-07**	1,116	1,116
Sc-46	125,000	397,000	100	**1.95E-05**	513	513
V-48	93,400	1,460,000	90	**2.16E-05**	417	417
Cr-51	4,790,000	43,700,000	6,000	**3.26E-05**	18,405	18,405
Mn-54	257,000	374,000	300	**2.23E-05**	1,345	1,345
Fe-55	557,000	631,000	2,000	**6.84E-05**	2,924	2,924
Fe-59	103,000	591,000	200	**5.14E-05**	389	389
Co-58	247,000	909,000	300	**2.96E-05**	1,014	1,014
Co-60	53,900	57,600	100	**5.20E-05**	192	192
Ni-63	1,220,000	1,220,000	50	**1.02E-06**	4,902	4,902
Zn-65	46,900	75,400	300	**1.23E-04**	244	300
Se-75	70,900	170,000	900	**2.65E-04**	340	900
Rb-86	65,900	892,000	600	**2.06E-04**	291	600
Sr-89	72,000	363,000	20	**1.66E-06**	1,205	1,205
Sr-90	6,650	6,730	8	**2.03E-05**	39	39
Y-90	68,800	6,530,000	60	**3.06E-05**	196	196
Y-91	78,100	341,000	90	**4.07E-05**	221	221
Zr-93	167,000	167,000	2,000	**8.55E-05**	2,339	2,339
Zr-95	192,000	773,000	200	**2.68E-05**	746	746
Nb-95	314,000	2,260,000	300	**2.16E-05**	1,389	1,389
Mo-99	306,000	28,100,000	600	**3.54E-05**	1,695	1,695
Tc-99	288,000	288,000	900	**7.28E-05**	1,236	1,236
Ru-103	252,000	1,620,000	200	**2.22E-05**	901	901
Ag-110m	66,500	106,000	90	**2.86E-05**	315	315
Cd-109	92,600	120,000	600	**9.81E-05**	612	612
In-114m	45,400	233,000	60	**4.37E-05**	137	137

* Units - picoCuries per Liter (pCi/L)

TABLE 6: CALCULATION OF REMOVAL ACTION LEVELS (RALs) and comparisons with Proposed Derived Response Levels (DRLs) and Existing Maximum Concentration Levels (MCLs)

Sn-113	251,000	620,000	300	**3.72E-05**	806	807
Sn-125	60,100	1,580,000	60	**3.41E-05**	176	176
Sb-124	72,900	311,000	60	**2.27E-05**	264	264
Te-127	1,100,000	712,000,000	900	**2.62E-05**	3,435	3,435
Te-129	2,940,000	15,300,000,000	2,000	**1.21E-05**	16,529	16,529
Te-129m	62,300	468,000	90	**4.07E-05**	221	221
Te-132	48,600	3,780,000	90	**2.13E-04**	42	90
I-132	48,600	3,780,000	90	**1.98E-04**	45	90
I-129	1,750	1,750	1	**4.22E-06**	24	24
I-131	8,490	267,000	3	**3.91E-06**	77	77
Cs-136	60,100	1,160,000	800	**2.42E-04**	331	800
Cs-137	13,600	13,800	200	**1.27E-04**	157	200
Ba-140	71,200	1,410,000	90	**3.91E-05**	230	230
La-140	91,600	13,800,000	60	**1.89E-05**	317	318
Ce-141	260,000	2,030,000	300	**3.93E-05**	763	763
Ce-143	165,000	30,400,000	100	**2.02E-05**	495	495
Ce-144	35,300	5,330,000	30	**2.60E-04**	12	30
Nd-147	171,000	3,940,000	200	**4.23E-05**	473	473
Pm-149	186,000	21,300,000	100	**1.88E-05**	532	532
Sm-151	1,890,000	1,890,000	1,000	**1.60E-05**	6,250	6,250
Eu-152	135,000	139,000	200	**1.84E-05**	1,087	1,087
Eu-154	90,700	94,300	60	**1.94E-05**	309	309
Eu-155	566,000	607,000	600	**3.27E-05**	1,835	1,835
Gd-153	665,000	1,070,000	600	**2.62E-05**	2,290	2,290
Tb-160	115,000	415,000	100	**2.50E-05**	400	400
Tm-170	140,000	320,000	100	**2.53E-05**	395	395
Hf-181	165,000	984,000	200	**3.64E-05**	549	550
Ta-182	120,000	297,000	100	**2.29E-05**	437	437
W-187	294,000	74,700,000	200	**2.11E-05**	948	948
Ir-192	135,000	477,000	100	**2.12E-05**	472	472
Au-198	116,900,000	80,000	100	**1.79E-05**	559	559
Hg-203	96,900	529,000	60	**5.70E-04**	11	60
Tl-204	156,000	170,000	300	**5.43E-05**	552	553
Bi-207	146,000	147,000	200	**3.31E-05**	604	604

* Units - picoCuries per Liter (pCi/L)

Errata

The Au-198 DRLs are correct in Table 1 but were incorrectly transcribed in the subsequent tables and figures. The correct DRL without decay is 180,000 pCi/L and with decay 16,900,000 pCu/L.