Overhead Transmission Line Easement and Right-of-Way Cases in Crete, Greece

A Statistical Analysis of 1220 Cases from 1974 to 2019

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***Abstract*—Overhead Transmission Lines (OTLs) are used to carry High Voltage (HV) between HV substations, usually constructed at long distances from each other, thus spanning across numerous different properties. Easements, a legal term for nonpossessory rights, are essential to the utilities in order to maintain a Right-Of-Way (ROW) for construction and maintenance purposes in a corridor of land underneath the lines, and also to enforce certain restrictions within that corridor, in order to ensure the safety of both the OTLs and the public. The exact details of ROW corridors' management vary between countries as the legislation and each utility's approach may differ. This paper focuses on 1220 easements/ROW cases regarding the isolated HV Transmission System of the Greek island of Crete from 1974 to 2019. The various related factors are discussed and a statistical analysis of the records is performed.**

Keywords-overhead transmission line; easement; right of way; building; restriction; safety; management; legislation

I. INTRODUCTION

Electric power transmission between High Voltage (HV) substations is widely performed through the use of HV conductors suspended at safe distances above the ground, using specially designed structures such as lattice towers and poles of various materials (metal, wood, concrete) [1]. The sum of all these components (supporting structures, conductors, overhead ground wires etc) constitutes what is generally known as an Overhead Transmission Line (OTL) [1]. Apart from the various technical aspects related to the design, construction, operation and maintenance of OTLs, a fundamental obvious issue regards to the fact that OTLs inevitably have to span over numerous, private or public, pieces of land. This has an obvious, yet difficult to estimate precisely, impact on property values [1-3]. Property devaluation combined with concerns regarding safety and the visual and environmental impact, has resulted to a mainly negative public perception towards OTLs, especially in the recent decades [1, 4-8]. Thus, even if purchasing the land under OTLs was economically feasible, it is highly unlikely that such agreements could be established with all owners for the whole route of an OTL. Further, the actual need is for the power utility in charge to have the right to visit the properties just for short periods of time (e.g. during construction, inspection or maintenance) and to enforce restrictions related to safety issues, for example tree trimming and restricting groundworks in vicinity of OTLs (potential issues resulting from such cases are shown in Figure 1) [1-4, 7]. For all these reasons, easements are usually preferred over actual purchases. An easement is a nonpossessory right to a property and although, legally, a Right-Of-Way (ROW) is just an easement allowing the passage over a third-party's property, the term is often generally used to describe all the easements granted to the power utility for a corridor of land under an OTL. The width of the corridor, and the easement type, generally depends on the OTL voltage value and the legislation in effect. The ultimate goals of these easements are to provide to the utility easy and safe access to the line when needed, as well as the legal means in order to restrict potential safety threat factors. Such factors include: construction and building activities of any kind (including additions in existing buildings/structures), groundworks of any kind (including dwelling, drilling, quarrying, excavating, landscaping etc), use of heavy machinery, irrigation works and related activities (e.g. use of water cannons, sprinklers etc), accumulation of flammable materials or garbage, fencing, initiating fires of any kind, flying objects, vegetation (including trees), lake, ponds, swimming pools etc [1, 7].

Information of the public regarding easement/ROW regulations seems to be a matter of importance for several utilities worldwide that have put out brochures and leaflets, keeping them publicly available at their websites (e.g. [9-21]). However, this is not the case in Greece as the aspect is neglected even in general information documents regarding HV Transmission (e.g. [22]) or its interaction with the environment (e.g. [23]). It should be noted that a thorough survey regarding the various factors related to easements/ROW among 27 different countries (again, not including Greece) can be found in [7]. Thus, this paper contributes by providing an insight on basic easement/ROW policies and regulations in Greece for 66 kV and 150 kV OTLs along with a statistical analysis performed on 1220 easements/ROW cases regarding the HV Transmission System in Crete, Greece. It should be noted that

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the investigated cases range from 1974 to 2019 and that, in these years, several factors have kept changing (e.g. utility organizational restructures, transmission system upgrades and expands, legislation alterations, mapping and topographic advancements etc) and thus a brief discussion of the background is presented in the following section.

Fig. 1. Examples of potential safety issues.

II. CASE STUDY DATA & BACKGROUND

A. OTL ROW/Easemets in Greece

In general, in Greece the construction of a power line is considered a work of public interest and the land and easements are acquired through expropriation [24]. The easements include the right of passage, the expropriation of land around each tower's base, additional restrictions of certain type of activities in the ROW corridor and the enforcement of building restrictions within the corridor. The actual area of land that is expropriated around the base of each tower depends on the tower type. The ROW width is set to 40 m for 150 kV OTLs when they are supported by lattice towers and 25 m when they are supported by metal poles. In case of 66 kV OTLs, the ROW width is set to 20 or 24 m when the OTL is supported by wooden structures and 40 m when it is supported by lattice towers. However, these values are not universally set by a single law or legislation act. Instead, each expropriated part is specifically mentioned in an announcement at the Official Government Gazette (OGG) [25]. In other words, essentially, a specific law is passed for each expropriation. This creates a rather puzzling image as OTLs may be gradually constructed, upgraded, partially merged, renamed etc [24]. It should be noted that the number of OGG issues related just to the OTLs in Crete are close to one hundred.

The building restrictions set within the ROW corridor also comprise a complicated result as there are two types of easements are enforced in ROW corridors in Greece: a) Type I that allows building constructions up to a certain height and b) Type II that fully prohibits any construction. Parts of the same OTL may fall under different easement types. To make matters worse, the OGG issues generally refer to km positions (which is a legal term and does not necessarily match the actual length of the line up to the position) and to drawings and maps that are not included in the announcements. The allowed building height mentioned above is also a complicated issue as some early OGG issues referred to a specific height from the ground. However, it soon became evident that this would cause risks in the future (as the landscape may be altered) and later expropriations use a phrasing that refer to a minimum distance from the conductors under certain environmental conditions (absence of wind and 50 ^{o}C temperature). This however ultimately means that the specific height has to be provided by the utility on a case by case basis.

The expropriation compensation is another source of confusion. The absence of a national cadastre in Greece combined with the usually remote routing of OTLs meant that the utility could not have precise information regarding the properties underneath the lines (owner, boundaries etc). Thus, the drawings and tables used for expropriations, referred to "alleged owners". Then, the exact compensation amounts were decided in local courts and, after that, a new announcement in an OGG issue followed, informing the public that a deposition in each owner's name is made by the utility in the national Deposit and Loans Fund. However, the actual data (owners' names, compensation amounts etc) were not provided in the OGG announcement and whoever interested had to refer to the hard copy court records, held in local court archives.

It should be clarified that a single OGG issue contains several different announcements (on different subjects) and tons of issues are published each year. The contents of all OGG issues have been digitized lately and remote public access has been provided [25]. However, older issues have been scanned without the use of optical character recognition techniques, making it impossible for the user to search using keywords e.g. in order to find the issue containing the announcement for the expropriation related to a specific OTL or to find a specific name of an alleged owner. Further, even if the OGG issue is found, the owner would still have no particularly useful information regarding a specific property as the OGG issue does not include the documents that contain these information.

To complete the general legal background, it should be stated that other laws may enforce general rules and restrictions on a property because of an OTL, even outside a ROW corridor (e.g. in case of gas stations, quarries, use of explosives, construction sites etc).

B. The Crete-Rhodes ROW office

In Greece, the power transmission system was historically constructed, maintained and operated by the Public Power Corporation (PPC) through several different divisions, sections and subsection. The Crete and Rhodes transmission systems were historically considered as a single administrative unit and their operation and maintenance was assigned to the same division. The exact placement of this division/section within the organization has changed through the years. Since the 2011 split up of PPC, it has been placed under the Islands Network Operation Department of the Hellenic Electricity Distribution Network Operator (HEDNO). It should be noted that HEDNO manages the Network but PPC maintains the ownership of the network's infrastructure which means that e.g. all ROW cases in Crete are handled by the HEDNO ROW office but PPC retains the ownership of the land and easements. Adding to the confusion, after the split-up all central Transmission System services (including the ones dealing with OTL construction, record keeping, expropriations, ROW corridor management in the rest of Greece etc) were moved to the Independent Power

Transmission Operator (IPTO) which is today a third party company.

Several internal changes within the parent division of the ROW office have also occurred over the years. In general, the ROW office has always been a part of the Transmission Line Operation and Maintenance Subsection but was never considered an isolated entity with devoted personnel. The situation gradually evolved, as personnel kept being reduced over the years, from ROW office people being occasionally, if not rarely, called for maintenance works, to the same handful of people performing all duties of the Transmission Line Subsection (including the duties of the ROW office).

C. Transmission system alterations

The Transmission System of Crete is currently operating at 150 kV and includes 20 High Voltage Substations [24] and the cumulative length of its OTLs is over 580 km [26]. However, back in 1974 there were only 5 substations and the OTL cumulative length was just over 360 km and operated mostly at 66 kV. These changes certainly have had an impact on ROW cases. Obviously as the network expanded, more properties were affected. The upgrading of OTLs meant that wider and higher towers were used which meant that additional expropriation of land for their bases was required and also that height restrictions would now be more favorable for the property owner (Figure 2).

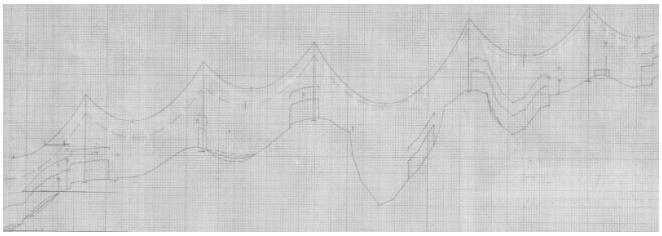

Fig. 2. Part of a typical drawing (side view) of an OTL before upgrading (dotted line) and after upgrading (solid line).

System upgrade from 66 kV to 150 kV also meant that all old 66 kV lines supported usually by wooden structures were gradually removed as their routing was judged unsuitable for further use. The conductors were removed and the poles were cut up to a height that would be significant enough to mark PPC owned land and at the same time pose minimal inconvenience and safety hazard (Figure 3). The removal of old 66 kV lines supported by wooden structures has had a huge impact in the city of Heraklion as two of these lines passed over fully urban areas. Another 66 kV OTL in the area, which was supported by lattice towers, was upgraded and parts of it were used as parts of a new 150 kV OTL. A part of this OTL that crossed residential areas of Heraklion was however taken off service and all conductors were removed whereas the lattice towers remained on the properties (Figure 4). The routing of the 150 kV OTLs in Heraklion is now kept away from residential areas as much as possible with the additional use of underground cables. An overview of Heraklion along with cable and past and present OTL routing is shown in Figure 5.

Fig. 3. Removal of an old 66 kV line supported by wooden poles. Left image: the wooden support structure (Screenshot from Google Earth, Image © 2018 Google, © 2019 Google, © 2018 BasarSoft). Right image: the current state.

Fig. 4. View of three lattice towers of an out off service 66 kV OTL which used to span over residential areas in Heraklion. All conductors and the overhead ground wire have been removed.

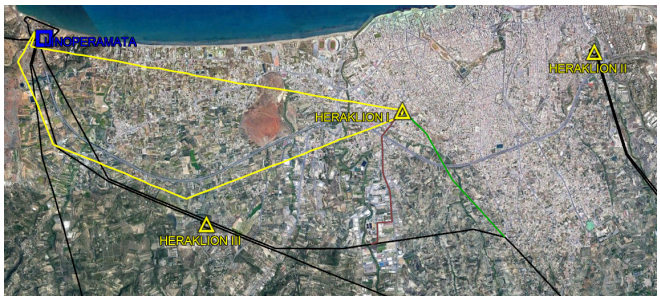

Fig. 5. An overview of Heraklion. The blue square denotes the step up substation of Linoperamata whereas the yellow triangles denote the step down substations Heraklion I, Heraklion II and Heraklion III. The yellow lines denote the routing of two old 66 kV OTL supported by wooden poles (now fully removed). The green line denotes part of an old 66 kV OTL supported by lattice towers that is now out of service (conductors removed). The brown line denotes the routing of 150 kV underground cables (Screenshot from Google Earth, Image © 2019 TerraMetrics. Map data: Data SIO, NOAA, U. S. Navy, NGA, GEBCO).

D. Topography and mapping issues

The history behind the still under-development National Cadastre in Greece, and the overall registration system, is thoroughly described in [27-31]. In short, the basic system in Greece has been unchanged since the early 19th century and operates as a paper-based public register of real property owners and the deeds that they have been involved in (basically, a Registrations and Mortgages system) [27-28]. Various offices operated throughout the country without any uniform/coordinated operation or service standards [27]. It should be noted that it is estimated that there are about 7.4 million property owners in Greece [29]. Also, that it had been usual for owners in the past (especially in remote areas) to acquire and pass the ownership using unofficial private agreements (often enough, such agreements were just verbal). In addition, the rights of the State and usucaptions were also

not registered [27-28]. In short, such a system could not identify individual real properties or boundaries and did not allow the identification of the owners of a property observed in the field [27]. Thus, there had been several attempts to develop a National Cadastre over the years [28]. The latest attempt that initiated in 1996 [27-31] has resulted in registering less than 10% of the area and 30% of the rights up to 2018 [27-28]. In Crete, just the urban areas of major cities were registered. However, the registration has picked up lately and a large part of Crete was registered in 2019 (Figure 6). During the OTL construction however, it obviously was not possible for the utility to have any positive information regarding the properties within a ROW corridor, which explains the "alleged owner" issue discussed earlier. It should be noted that there had not been any entity or public service where a property owner could ask for the slightest information regarding the easements on their property (not even the existence of such easements), other than the ROW office.

Fig. 6. Areas of Crete (with bright solid color) registered in the national Cadastre in 2019, including over 7,000 different easement cases and expropriated areas. Solid black lines depict the axes or overhead transmission lines, blue rectangles denote step up substations and yellow triangles denote step down substations. (Screenshot from Google Earth, DATA SIO, NOAA, U.S. Navy, NGA, GEBCO, Image Landsat / Copernicus).

It should also be noted that there have been several changes in the coordinate systems used in Greece over the years [24]. Similarly, changes regarding the registration rules and/or the data needed to be registered have also taken place. These changes also included the necessity of providing coordinates under a country-wide coordinate system during the registration or mapping of a property, which was relatively recently added. This means that even if an ownership had been registered or a property had been mapped in the past that does not mean that the available information/diagrams/maps included the necessary information to provide a geospatial representation. Needless to add that the absence of such requirements was also depicted in the construction sheets of OTLs and thus a new project had to be initiated recently in order to provide a geospatial representation of OTLs in Crete and Rhodes [24]. In relation to the properties in ROW corridors, it was also usual for past ROW office documents to refer to the relative position of the property from a tower, using a custom naming system for towers (usually following an incremental numbering system from one substation to another) [24]. However, as the power system developed over the years, OTLs were merged, partially removed, expanded etc and towers may be added, moved or renamed and thus the relative position from a tower cannot be considered a trustworthy information for a correct geospatial representation of ROW cases[24].

III. DATASET INFORMATION

A. General information

The analysis presented in this paper aims to provide an insight of the easement/ROW cases for the OTLs of the Transmission System of Crete from 1974 to 2019. The hard copy files considered are contained in 72 A4 large lever arch folders shown in Figure 7.

Fig. 7. The 72 folders containing the hardcopy files

Some key remarks regarding the data set have to be noted however:

- The official division's records include all correspondence conducted via all the different sections of the division archived in a yearly basis. Up until few years ago, these records were hard copy only. In general, for practical reasons, they do not include attached documents as yearly correspondence includes the transfer of large data (manuals, drawings, schematics, maps, topographic plans etc). This means that going through the official records to identify ROW cases would be a rather tedious task that would ultimately produce insufficient information.
- Thus, the files considered in this paper are the hard copies kept within the ROW office. These records are informal, include the attached drawings and schematics and were kept mostly with the purpose of case monitoring.
- The mapping/topography issues along with the transmission system alterations discussed in previous sections, has led to cases being identified by the property owner's name(s) in the files, which provided an easier to work with approach.
- An effort to have all entries in the hard copy records digitally organized started in 2018, with an entry for each new case made upon initiation. The general approach for previous cases was to assign to them the year of last correspondence. However, the vast majority of cases initiated and concluded in the same year and thus the impact of non-consistent year assignment can be considered insignificant.
- A number of 107 cases fell under two or more categories. These are considered as different cases in this analysis although they were not separated in the hard copy records. The actual number of the hard copy entries is 1107. They

include 102 cases that fall under a second category (which increases the sum by 102), 5 cases that fall under 3 categories (which increase the sum by 8) and 1 that falls under 4 (which increases the sum by 3).

B. Issues not included in the data set

1) Vegetation management (including tree trimming)

Worldwide, tree trimming and vegetation management is considered an important aspect of OTL ROW management, mainly aiming to ensure the safety of the OTL (e.g. from falling tree/branches as shown in Figure 1) and easy and safe access to the supporting structures [1, 7-21, 32-35]. The development of the Transmission System in Greece initiated in 1953 (1968 for Crete) [22] and trimming instructions back from 1957 can be found in Islands Network Operation Department's hard copy archives, [34]. Tree trimming and vegetation management are matters of significant importance in Greece mainly due to fire hazard laws and fire preventing measures [34-35] and thus both these issues are individually monitored.

2) Cadastre registration, OTLs alterations, asset appraisal

Several issues of major significance are also individually monitored and thus not included in the considered records, such as the gradual registration of easements and expropriated tower base areas in the national cadastre (over 7,000 just for the areas registered in 2019, shown in Figure 6), any system alterations regarding OTLs, periodical asset appraisal (including expropriated areas and easements) etc.

3) Property damages, vandalisms, correspondence

Minor ROW corridor issues such as property damages (e.g. damages to crops/trees etc) due to the passage of utility crews, internal correspondence within the utility, internal or external correspondence regarding the progress of current works, cases of vandalisms/shootings etc are dealt with as part of the run-of-the-mill work of the Transmission Line Subsection and thus are not included in the records considered in this paper.

IV. DATASET ANALYSIS & RESULTS

A. Main categories and results

A breakdown of the considered 1220 cases in different categories is shown in Figure 8. A further discussion on each category is given in the following subsections.

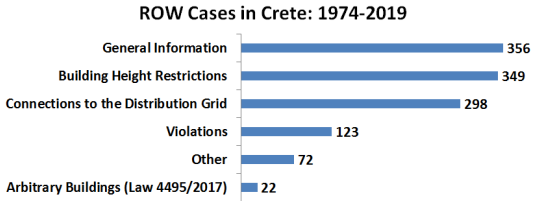

Fig. 8. A breakdown of the 1220 cases

1) General Information: 356 cases (29.18%)

This category includes all queries about general information related to OTLs (Transmission System information, ROW/easements legislation, specific easements enforced on specific properties etc). Such cases cover about one third of the dataset. The vast majority of these cases (298 out of 356) are cases referring to the request of one (or more) pieces of basic information such as the existence (or not) of easements on a property, the nature of these easements, the exact OGG issues referring to these easements, the related maps/drawings, the expropriation and compensation procedure, the expropriated area on a specific property etc. The remaining 58 cases include requests for information further broken down in categories as shown in Figure 9. Most notably, there have been 33 cases that are related to city and urban plans under development. Such cases usually regard a large area. Details on the routing (and easements) of OTLs in this area are requested in order to be considered during the city/urban plan development. There have also been 15 cases of property owners requesting information regarding the state of easements enforced on properties in the ROW corridor after the removal of the OTL. As shown, cases regarding information about gas stations, quarrying and drilling in proximity of OTLs are rather rare (4, 4 and 1 respectively) which can be attributed to the routing of the lines and the rarity of the latter two activities.

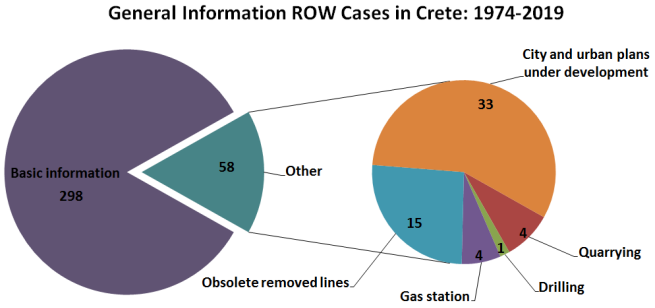

Fig. 9. General Information cases

2) Building Height Restrictions: 349 cases (28.60%)

As explained in section II-A, ROW legal statute in Greece either fully prohibits any construction in the ROW corridor or enforces height restrictions. These height restrictions, for cases from all over Greece, were historically issued by a PPC division stationed in Athens which was moved to IPTO after the PPC split-up in 2011. Thus, the actual issuing of building height restrictions is a service now outsourced to IPTO with HEDNO's ROW office in Crete maintaining its historical role as the on-site expert (handling requests, provide on-site measurements, background information regarding the OTL and its legal background etc). The number of such cases per year is shown in Figure 10, with a dotted line depicted the time of the split up, after which issuing height restrictions was outsourced to IPTO.

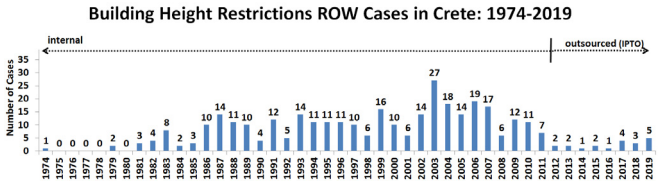

Fig. 10. Building Height Restrictions cases per year

3) Connections to the Distribution Grid: 298 cases (24.42%)

As a part of standard procedure, when a property in proximity of an OTL is requested to be connected to the distribution grid, the assent of the utility in charge of the OTL is required. In Crete, HEDNO handles both distribution and transmission through different departments that are further divided in sections and, in case of distribution, local offices. Thus, when a property located near an OTL in Crete is requested to be connected to the low voltage grid, the HEDNO distribution section having the jurisdiction in the area contacts the Islands Network Operation Department and, ultimately, the ROW office which, after checking that all rules and regulations are followed, assents to the request (or asks for remedies if easement violations are spotted). Occasionally, owners include additional requests along their request for connection to the distribution grid. Thus, 50 of the 298 "Connection to the Distribution Grid" cases also fall into another category, as shown in Figure 11.

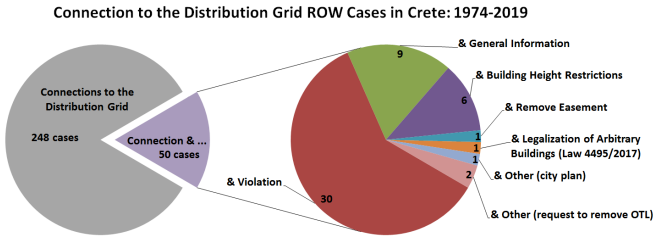

Fig. 11. A further breakdown of the Connection to the Distribution Grid category

4) Violations: 123 cases (10.08%)

When easement violations are spotted, the ROW office contacts the property owner (as well as other services that may be involved) aiming to remedy the situation. A number of 123 violation cases are included in the considered data set (Figure 8). A large percentage of these cases (54 out of 123 or 43.9%) regard properties located in the ROW corridors of now removed 66 kV OTLs which spanned through the city area of Heraklion and were also elevated at low heights, mostly supported by wooden structures, as explained in section II-C and shown in Figures 3-5. The majority of the considered violation cases is in fact related to –now obsolete- 66 kV lines throughout Crete (73 out of 123 or 59.34%), as shown in Figure 12. This can be attributed to both the lower heights that 66 kV lines reached and to their route.

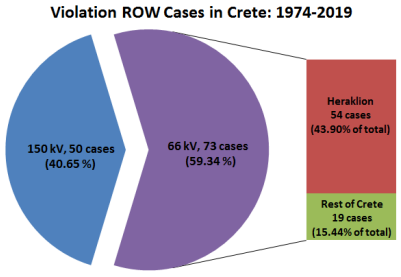

Fig. 12. A breakdown of the 123 violation cases

5) Other: 72 cases (5.90%)

This category includes 72 issues that are further broken down to subcategories (Figure 13) such as: requests to remove easements from properties in the ROW corridor of obsolete (removed) lines (21 cases), requests for a change in easement type (6 cases), requests to remove an OTL from a property (24 cases), lawsuits related to ROW/easements (14 cases) and groundworks and use of heavy machinery under an OTL (7 cases).

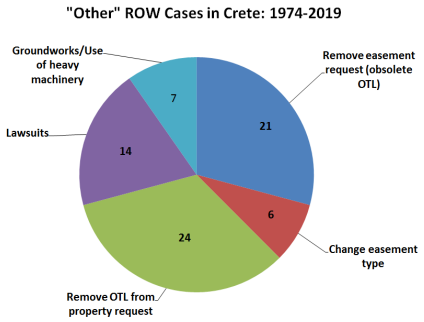

Fig. 13. Further breakdown of "Other" category

6) Arbitrary Buildings (Law 4495/2017): 22 cases (1.80%)

The most recent law regarding the legalization of arbitrary buildings in Greece (law 4495/2017, effective since November 3, 2017), demanded owners of arbitrary buildings within ROW corridors to acquire a certification of compliance to "all restrictions" in order to move forward the legalization procedure. It should be noted however that both law 4495/2017 and its predecessor (law 4178/2013) used some unfortunate phrasing that had an impact on the cases included to other categories. Law 4495/2017 stated that the compliance certificate was to be issued by the Independent Power Transmission Operator (IPTO), neglecting that the OTLs of Crete and Rhodes are PPC owned and under HEDNO jurisdiction and law 4178/2013 referred to "high voltage transmission lines of current over 150 kW". Thus, following the adoption of these laws, several queries have been submitted regarding e.g. the voltage used by the Transmission System, the role of HEDNO (and/or IPTO) in Crete and even, in some rare cases, requests for a certification stating that the Transmission System carries "current of 150 kW". Such queries could not be directly related to the legalization of arbitrary buildings and are thus classified in this paper under the General Information category.

B. Further Insight

1) Temporal analysis

A breakdown of the 1220 of cases per year, along with a 5-year moving average, is shown in Figure 14. As shown, the number of cases during the first years is relatively small (5 to 12 per year) a fact that can be attributed to the size of the network and to its recent construction at the time. By 1980, the number of cases per year exceeds 20 and it generally shows an increasing trend up to 2011. The maximum number of cases is recorded in 2002 (58 cases) with three more years having over 40 cases (1991: 45, 2003: 45, 2006: 48). It should be noted that,

there are several contradicting factors that may influence these results. For example, the expansion of the transmission system is a factor that is obviously expected to cause an increase. However, the removal of obsolete 66 kV lines counteracts that influence. Although the decrease of overall OTL length due to their removal is minor, their routing (in some cases through residential areas) results to a disproportional impact on the ROW office workload. Thus, it is not easy to pinpoint the exact causes for the recorded fluctuations.

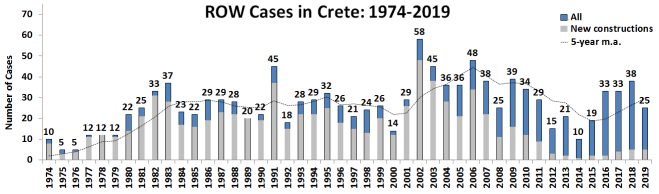

Fig. 14. A temporal breakdown of the cases in the considered data set.

Two turning points (2011 and 2018) should be further discussed however. As shown in Figure 14, cases related to new constructions steadily represent a large part of the cases recorded each year up to 2011. However, their contribution is significantly decreased after 2011. This should be attributed to the 2011 financial crisis [36]. Further, an overall increase of cases is recorded after 2015 and especially after 2016. These are the years that laws 4178/2013 and 4495/2017 were in effect. As mentioned earlier, the exact impact of law 4178/2013 can not be determined due to its phrasing. However, this is not the case with law 4495/2017. Thus, the 2011-2019 and 2018-2019 periods are further discussed in the following subsections.

2) 2011-2019: Financial Crisis

As shown in Figure 14, there has been a general decrease of the number of cases related to new constructions (violations, issuing height restrictions, connections to the distribution grid) that can be largely attributed to the general decline of construction activity due to the financial crisis that hit Greece in 2011 [36]. A closer examination of the dataset shows that the overall percentage of such cases for 1974 to 2010 is 73.92%, The percentage of such cases for the decade right before the crisis reaches 65.98% but it falls to 14.80% for 2011-2019 (Figure 15).

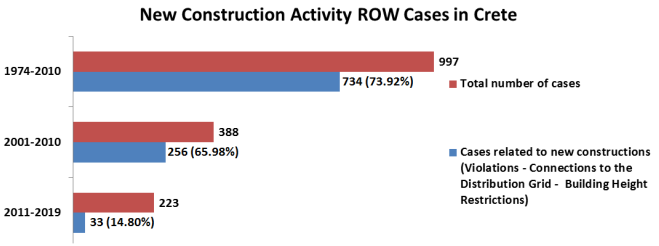

Fig. 15. ROW cases related to new construction activity in Crete: the impact of the 2011 finanical crisis.

3) 2018-2019: Law 4495/2017

In 2018-2019, basically the time that law 4495/2017 has been in effect (adopted on November 3, 2017), the ROW office has already handled 22 such cases. This number is almost negligible if one considers the full 1974 to 2019 time span. However, if one considers just the 2018-2019 period, then the percentage of this category rises to 30.16% (19 out of 63). Thus, a further insight of the cases recorded in the last two years is given along with a comparison to the 1974-2019 period is given in Figure 16. As shown, the legalization of arbitrary buildings is the second most dominant category in 2018-2019, behind the General Information category that remains the most dominant one with 22 out of 63 cases (34.92%). In fact, law 4495/2017 has also had an impact on the cases regarding requests to change the easement type on a property further discussed in the following subsection, as owners moving to legalize a building may have to ask for such a change first.

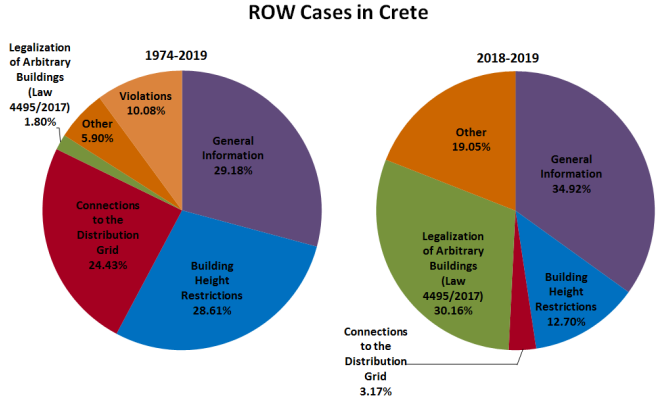

Fig. 16. ROW cases in Crete: 1974-2019 and 2018-2019.

4) 2018-2019: Other Factors

It should be noted that, as shown in Figure 16, the "Other" category ranks third in 2018-2019 (12 out of 63 or 19.05%). Its respective percentage for 1974 to 2019 is 5.9% and for 1974 to 2017 is just 4.91% (60 out of 1220). A closer look to the 12 cases recorded in the last two years (2018-2019) shows that they include 5 requests to remove easements from properties in the ROW corridor of obsolete (removed) lines, 2 lawsuit cases, 3 groundworks/use of heavy machinery cases and 2 requests for a change in easement type. A comparison with 1974-2017 is shown in Figure 16 through a per year calculation.

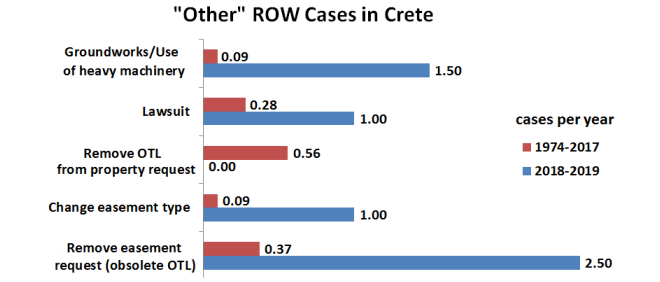

Fig. 17. A per year calculation of the "Other" subcategories for 1974 to 2017 and 2018 to 2019.

It should be noted that the increase recorded in cases regarding easement removal requests and lawsuits can be

attributed to the general gradual realization of the public regarding the role of the National Cadastre. Easements are now easily documented and thus owners are moving to have them removed from the Cadastre record of properties. Further, the procedure in Greece calls for owners that do not agree with a property's registration data in the National Cadastre, to file lawsuits against all parties related to this property, including easement owners. Finally, as stated in the previous subsection, the requests to change easement types are sometimes a prerequisite for the legalization of an arbitrary building. Thus, an increased number of such cases is expected to keep being recorded in the following years. This is not however the case with other, purely coincidental, cases such as groundworks/use of heavy machinery or requests to remove OTLs.

V. DISCUSSION

This paper discuss a total of 1220 ROW cases regarding the isolated HV transmission system of the Greek island of Crete from 1974 to 2019, as found in the hard copy records of the ROW office. The hard copy records considered are informal files kept mainly for case monitoring. Different employees and even different divisions have been involved in the handling of easement/ROW corridor cases through the years. It is thus possible that the records of some cases may be missing or be incomplete. However, the time span and the number of cases are sufficient to provide a representative image and to acquire some useful insights.

Some key points follow:

- The most usual ROW cases in the considered files are related to queries for general information, building height restrictions, safety violations (e.g. clearance) and connections of properties within the ROW corridor to the low voltage grid.
- More infrequent cases include queries related to city plans under development, obsolete OTLs, drilling, quarrying, gas stations, groundworks, use of heavy machinery and public opposition to OTLs.
- The absence of a public information policy is clearly depicted in the results. Queries for general information are the dominant category from 1974 to 2019, with a percentage over 29% (356 out of 1220 cases). Queries for the most basic information, usually available through leaflets and the utility's webpages in other countries, are responsible for almost one quarter of the recorded cases (24.42% or 298 out of 1220 cases).
- This is also hinted by the fact that there have been 30 cases where owners of buildings within the ROW corridor requested to be connected to the low voltage grid and that request led to the utility spotting an easement violation, which means that the owners were either unaware of the existence of easements or of their exact nature.
- Cases related to construction activity (building height restrictions, violations, connections to the distribution grid) reduced tremendously in 2011-2019, a direct result of the financial crisis that initiated in 2011.
- Building height restrictions are outsourced to IPTO since the PPC split-up in 2011, with the HEDNO ROW office in Crete acting as the on-site expert. The number of such cases per year since 2011 however, hardly justifies hiring the extra personnel necessary to perform the now outsourced part of this task (2.5 such cases per year with a maximum of 5 in 2019). Hiring additional personnel however, is an option that should be considered if there is a significant increasing trend for such cases in the future.
- Transmission Line route planning and design has a huge impact on maintaining safety clearance throughout the life time of the line. Almost 60% of the recorded clearance violation cases since 1974 are related to 66 kV lines (59.34% or 73 out of 123 cases) although it's been decades since the last 66 kV was taken off service. Almost half of all violations (43.9% or 54 out of 123 cases), are related to 66 kV lines that spanned through urban areas of Heraklion city.
- Recent major changes in Greek state's policy such as the adoption of a law for the legalization of arbitrary buildings and the gradual implementation of a National Cadastre has had a major impact on the nature of ROW related queries/cases. This is a trend expected to grow in the following years.
- Obsolete lines continue to be responsible for a good percentage of ROW workload even after their removal from properties, as utility easements remain after the removal of the line. The current policy for easements on routes of obsolete and removed OTLs is that each owner is expected to contact the utility individually and initiate the procedure to lift easements and buy back expropriated areas. It is doubtful that the potential financial gain from these purchases would cover the costs of geospatial mapping these lines, individual case handling and of registering rights in the National Cadastre. Abolishing easement rights in case of obsolete lines following unattractive routes that are not yet registered in the National Cadastre may in fact be a cost-savvy approach that could also be considered as a corporate social responsibility action, improving the public perception towards the utility and OTLs.
- Projects such as vegetation management, National Cadastre registration, OTLs alterations and asset appraisal are individually monitored and not included in the cases considered in this paper. Further, issues such as property damages, vandalisms and all other types of correspondence are also not included as they are considered a part of everyday work of OTL maintenance.
- The considered files do not provide a full image of the workload of the ROW office, as they do not include the substantial amount of verbal and unofficial communications conducted for each recorded case. A large portion of the ROW office's workload also not depicted in the files, is the handling of general information queries conducted in an unofficial manner (e.g. in person or via phone) that do not actually result to the submission of an official hard copy query.

VI. CONCLUSION

Overhead Transmission Lines' easements and right of way management is a key issue for every transmission system utility. Each utility is expected to ensure safe operation and maintenance of Transmission Lines along with their hazardless adjacency to private properties and structures under or in their vicinity. The exact policies followed, as well as the legislation, vary from country to country. This paper focuses on the Greek island of Crete, providing an insight on 1220 recorded cases from 1974 to 2019, as retrieved from the hard copy records of the ROW office in charge. A statistical analysis is performed focusing on the breakdown in different categories, the temporal variation and the impact of specific key factors. The Cretan system's evolution, its current state and a variety of local factors and their effect on the data are further discussed in order to provide a better interpretation of the results.

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